

Expert System for Short-term Abdominal Pain (Stomach Pain) Diagnosis and Treatment

Marah M. Al-Masawabe, Samy S. Abu-Naser

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

Abstract: Background: Abdominal pain is a common term for any disease symptom that affects the area between the chest and the pelvis (the abdominal wall or the organs in the abdomen) depending on the severity, duration and location of the pain. Therefore, in this paper, we will get to know all the diseases that can affect the abdomen with its organs and the pelvis as well, and detect the symptoms associated with each disease. Besides the pictures that illustrate each disease. **Objectives:** People do not feel pain in the normal situation. Therefore, when there is any feeling of pain, the disease must be detected and diagnosed. The main goal of this expert system is to obtain an appropriate diagnosis for abdominal pain (stomach pain). **Methods:** In this paper, this expert system is designed for the ability of doctors to detect and diagnose disease of Abdominal pain (Stomach Pain) like as: ECTOPIC PREGNANCY OR MISCARRIAGE, APPENDICITIS, DIVERTICULITIS, ULCER, PANCREATITIS, GALLSTONES, INFLAMMATION, KIDNEY STONE, BLADDER INFECTION OR KIDNEY, ULCERATIVE COLITIS, CROHN'S DISEASE, GASTROENTERITIS, CONSTIPATION, HEMORRHOID, ANAL FISSURE, ULCER, PELVIC, INFLAMMATORY DISEASE (PID), CYSTITIS. This system presents the disease symptoms such as slower abdominal or pelvic with Treatment of the disease and image for each disease. Clips and Delphi expert system languages are used for designing and implementing the proposed expert system. **Results:** This expert system in the diagnosis of Abdominal pain (Stomach Pain) was assessed by doctors and they were satisfied and accepted with its quality of performance. **Conclusions:** This expert system is easy for doctors and people have experience in the Abdominal pain to detect and diagnosis the symptoms that may face people from several disease.

Keywords: Expert Systems, CLIPS, Delphi, Abdominal pain (Stomach Pain).

1. INTRODUCTION

Dull pain in the abdomen is often common. But sudden, severe pain in the abdomen always indicates a big problem. Abdominal pain is a source of stress, fear, and anxiety in very young or old people who are sick and have HIV infection. The severity of abdominal pain is often lower, especially for people of old age compared to young people who suffer from the same pain, also children, including newborns, may suffer from abdominal pain. The Human abdomen contains many vital organs: the stomach, the small intestine (jejunum and ileum), the large intestine (colon), the liver, the spleen, the gallbladder, the pancreas, the uterus, the fallopian tubes, the ovaries, the kidneys, the ureters, the bladder, and many blood vessels (arteries and veins). [1] [2]

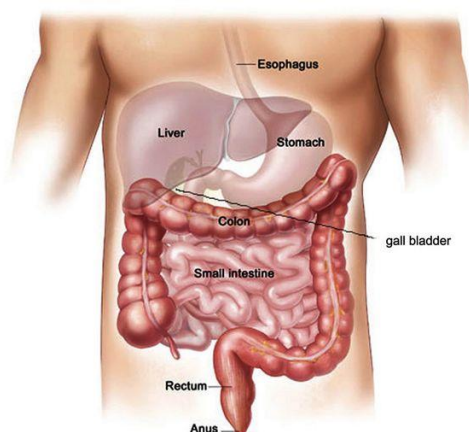


Figure 1The human abdomen

All of above are subject to the occurrence of pain in them. There are many causes of abdominal diseases, if you know where and when the pain is, easy it will be to diagnose these diseases.

The most important diseases mentioned in the paper are:

1. **ECTOPIC PREGNANCY OR MISCARRIAGE:** An ectopic pregnancy occurs when a fertilized egg implants outside the uterus (womb). Any damage to the fallopian tube can block or narrow the fallopian tube. There could also be problems with the tube walls, which should normally tighten and carry the fertilized egg into the uterus. A miscarriage is an event that results in the loss of a fetus before 20 weeks of pregnancy. It typically happens during first three months, of the pregnancy. [3] [4]

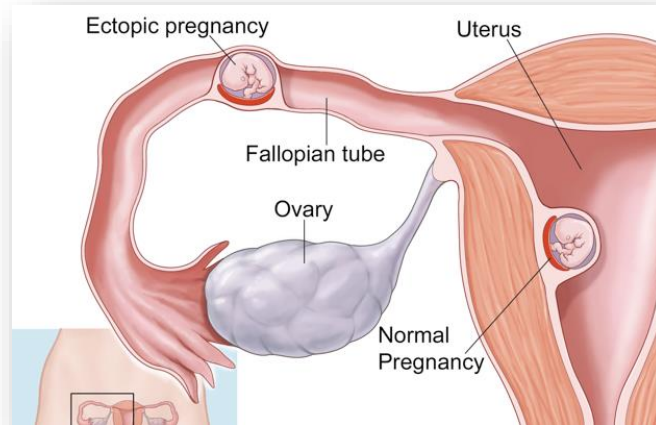


Figure 2An ectopic pregnancy

The disease can be diagnosed if the following symptoms are present:

- Abdominal pain that is severe, constant and knife-like.
- If you pregnant, or you believe you might be pregnant.

2. **APPENDICITIS, DIVERTICULITIS, ULCER, PANCREATITIS:** *Pancreatitis* is a disease in which the pancreas. The pancreas is a large gland behind the stomach and next to the small intestine. [5]

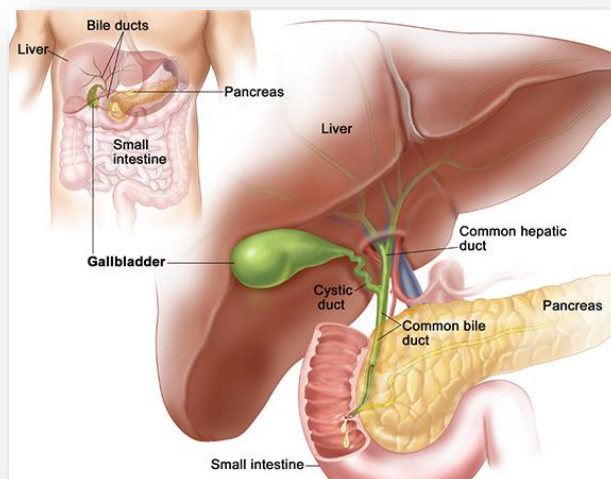


Figure 3 Pancreatitis

The disease can be diagnosed if the symptoms found are Stomach very tender to touch and Bloody diarrhea or stools that are black or tarry.

3. **GALLSTONES, INFLAMMATION:** *Gallstones* are parts of solid material that form in your gallbladder, a small organ under your liver and *Inflammation* refers to process of fighting against things that harm body, such as infections, injuries, and toxins, in an attempt to heal itself [6].

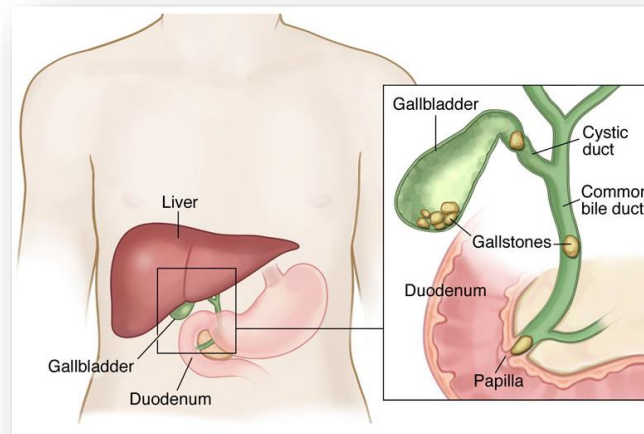


Figure 4 Gallstones

The pain start in upper middle or upper right abdomen and shift to back, and it does occur or worsen when eat fatty or greasy food.

4. **KIDNEY STONE , BLADDER INFECTION OR KIDNEY:** Kidney stones are hard deposits made of minerals and salts that form inside your kidneys.

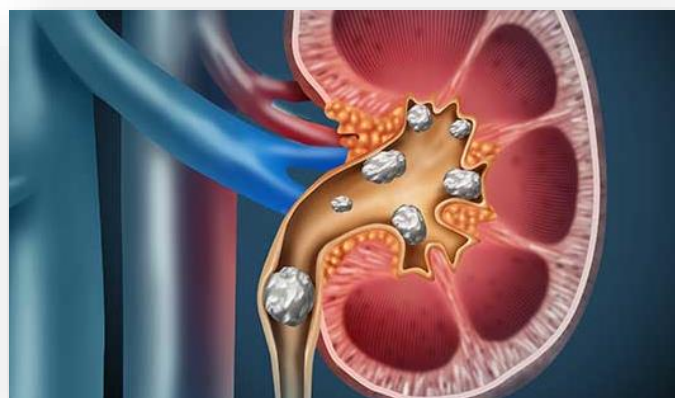


Figure 5 Kidney stones

The disease can be diagnosed if the symptoms found are Sudden sharp pain that starts in the back near the ribs and moves down toward the groin.

5. **ULCERATIVE COLITIS OR CROHN'S DISEASE:** are the two main forms of inflammatory bowel diseases. They are both conditions characterized by chronic inflammation of the digestive tract. [7]

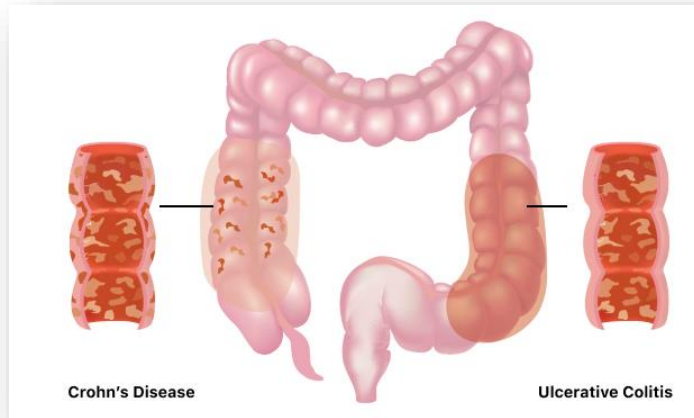


Figure 6 ULCERATIVE COLITIS - CROHN'S DISEASE

Pain in the right lower abdomen and blood or mucus in the stool.

- 6. **Gastroenteritis:** is an inflammation of the lining of the intestines caused by a virus, bacteria, or parasites.

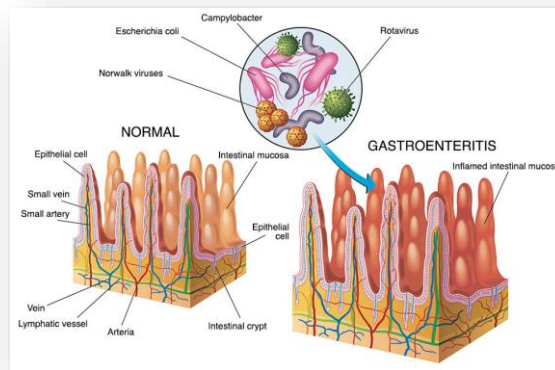


Figure 7 Gastroenteritis

The disease can be diagnosed if the symptoms found are Mild pain or burning pain in the upper abdomen, cramping pain that comes and goes, watery diarrhea, fever, muscle aches, chills, nausea, or vomiting.

- 7. **CONSTIPATION, HEMORRHOID, ANAL FISSURE:** in the anus, are sometimes confused with hemorrhoids.

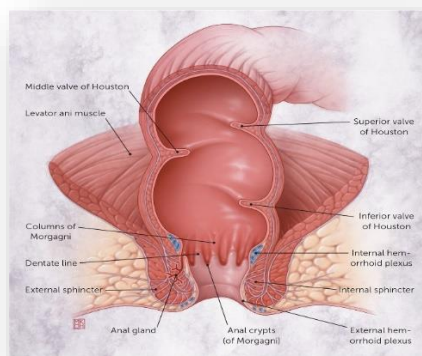


Figure 8 HEMORRHOID

These are inflamed blood vessels in, or just outside, the anus. bloating or distension of your abdomen, strain when a bowel movement.

- 8. **ULCER:** is sores on the lining of your stomach or small intestine. Sores also could be on your esophagus. [8]

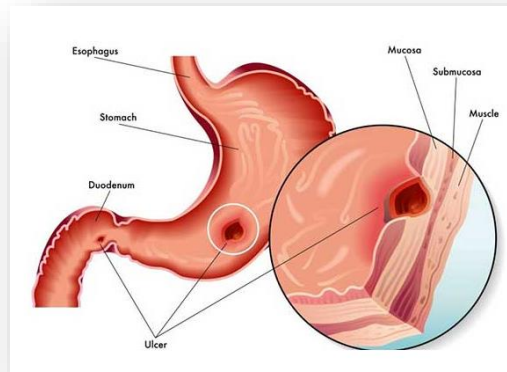


Figure 9 ULCER

Pain or a burning sensation in the upper abdomen that worsens or gets worse when eating.

9. **PELVIC, INFLAMMATORY DISEASE(PID):** is an infectious and inflammatory disorder of the upper female genital tract, including the uterus, fallopian tubes, and adjacent pelvic structures. [9]

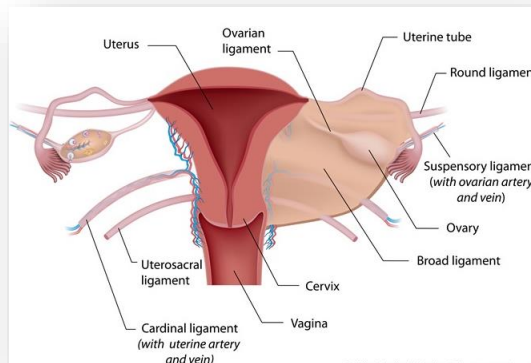


Figure 10 PID

A constant pain in the lower abdomen along with a vaginal discharge to women.

10. **CYSTITIS:** is an inflammation of the bladder. Inflammation is where part of the body becomes irritated, red, or swollen.

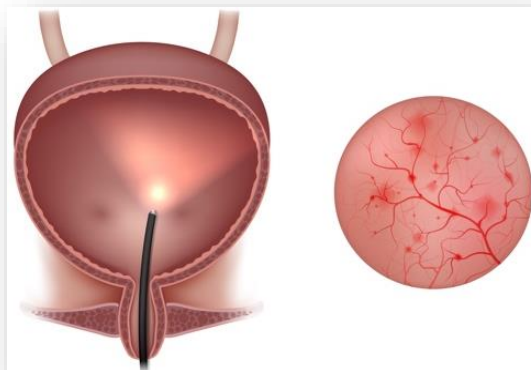


Figure 11 CYSTITIS

A mild pain, discomfort, or a feeling of pressure in the lower abdomen along with a burning sensation when you urinate.

2. LITERATURE REVIEW

A lot of expert systems that were designed to diagnose human diseases, which helps doctors to diagnose Abdominal pain like:

Web-Based Expert System to Diagnose Gastroenteritis in Children [10], Expert System for Diagnosis of Inflammatory Bowel Disease [11], A Mobile Expert System for Diagnosing Kidney Diseases [12], Internet based expert system for the management of gallstones, renal ureteric and bladder calculi [13], Development of a Medical Expert System for the Diagnosis of Ectopic Pregnancy [14], Kidney Expert System Diseases and Symptoms [15], Expert system urination problems diagnosis [16], Knowledge Based System for Long-term Abdominal Pain (Stomach Pain) Diagnosis and Treatment [17], and other kinds of diseases. However there no expert system found to diagnosis the Abdominal pain (Stomach Pain), short term.

3. Expert System

The expert systems are the computer applications developed to solve complex problems in a particular domain, at the level of extra-ordinary human intelligence and expertise. The Characteristics of Expert Systems, High performance, Understandable, Reliable and Highly responsive. [18] The components of ES include:

- Knowledge Base: contains the information acquired by interviewing experts, and logic rules that govern how that information is applied.
- Inference Engine: interprets the submitted problem against the rules and logic of information stored in the knowledge base.
- User Interface: allows the user to express the problem in a human language such as English.

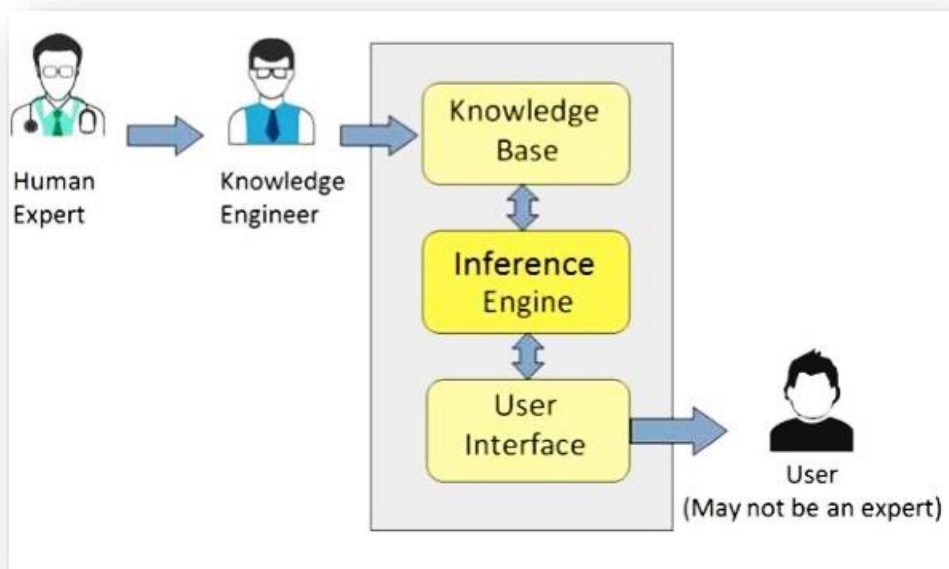


Figure 12 Expert System components

4. KNOWLEDGE REPRESENTATION

I could build an expert system: Smart Abdominal Diagnoses that can diagnose 10 different abdominal diseases using only 10 questions and give appropriate recommendations. I used expertise that is stored in a specialized website namely (www.familydoctor.org). Smart Abdominal Diagnoses can deduce the diagnosis using some questions which the user must answer with (yes) or (no) thereafter it can give him or her the diagnosis with a recommendation.

5. MATERIALS AND METHODS

- a) **Data collection:** the main expertise knowledge used in this system is taken from the familydoctor.org is trusted, reliable health information for the whole family provided by The American Academy of Family Physicians (AAFP). The AAFP was founded to promote and maintain high quality standards for family doctors. Family doctors take care of the physical, mental, and emotional health of the whole family and to any age.

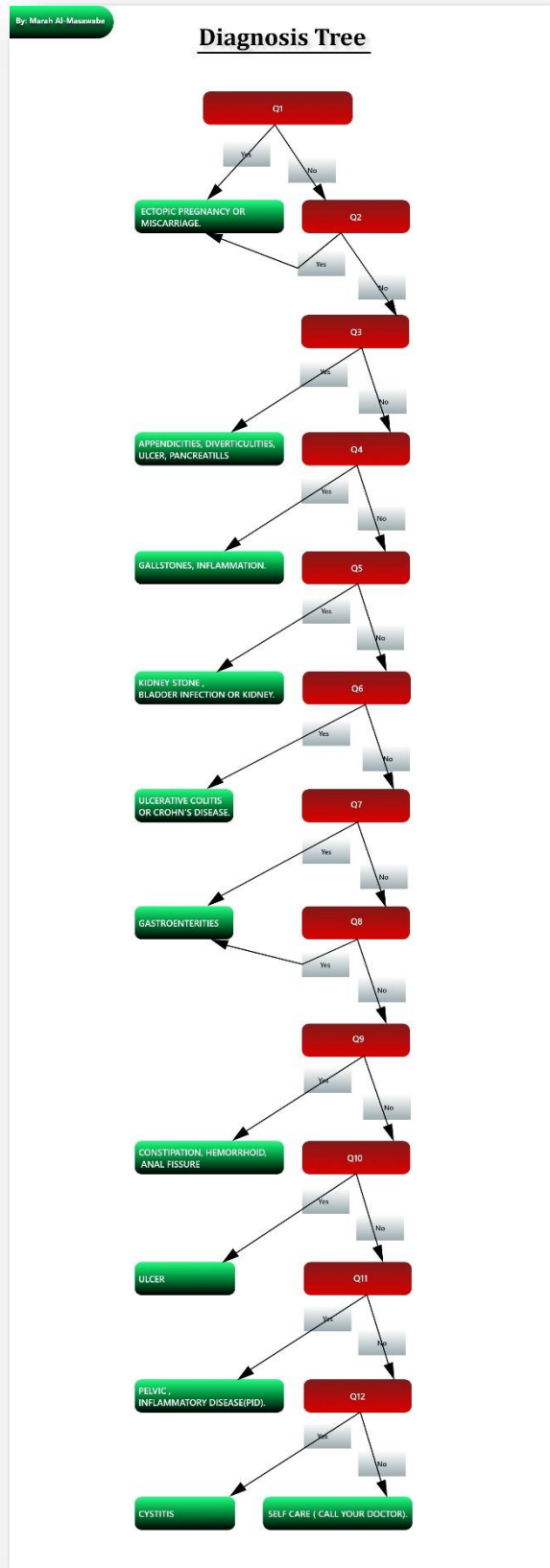


Figure 13 Abdominal pain Diagnosis Tree

- b) Knowledge is represented as a decision tree. The decision tree is used in the markup process.
- c) The programming language used to complete the project was CLIPS. CLIPS is a public domain software tool for building expert systems.

Figure ٤ Display format of the main page in expert system

Figure ٥ Display the basic data for expert system

Figure ٦ Display format of selection symptoms.

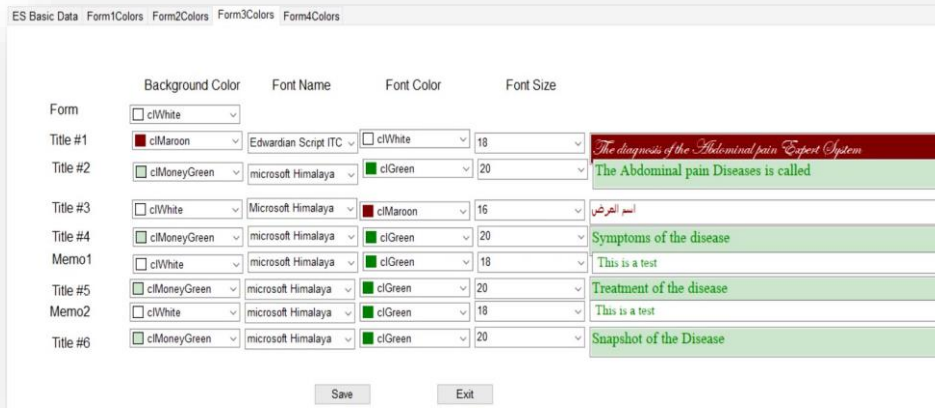


Figure 17 Display format of details screen of disease

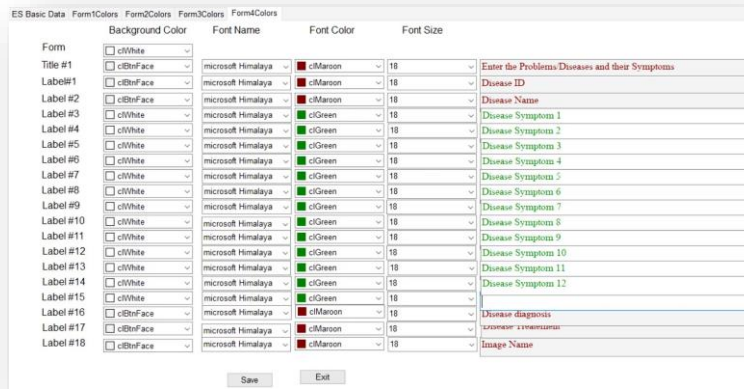


Figure 18 Display the format of entering diseases details

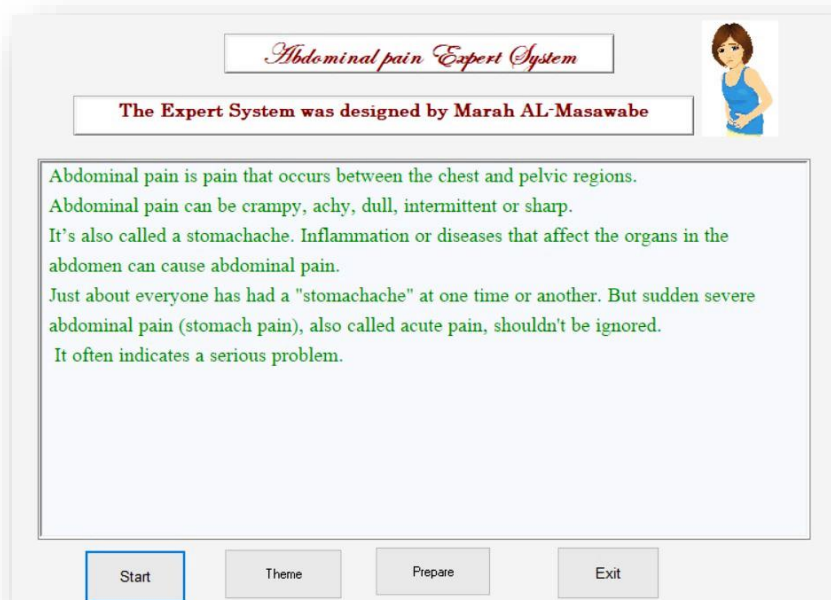


Figure 19 Main page of Abdominal pain expert system

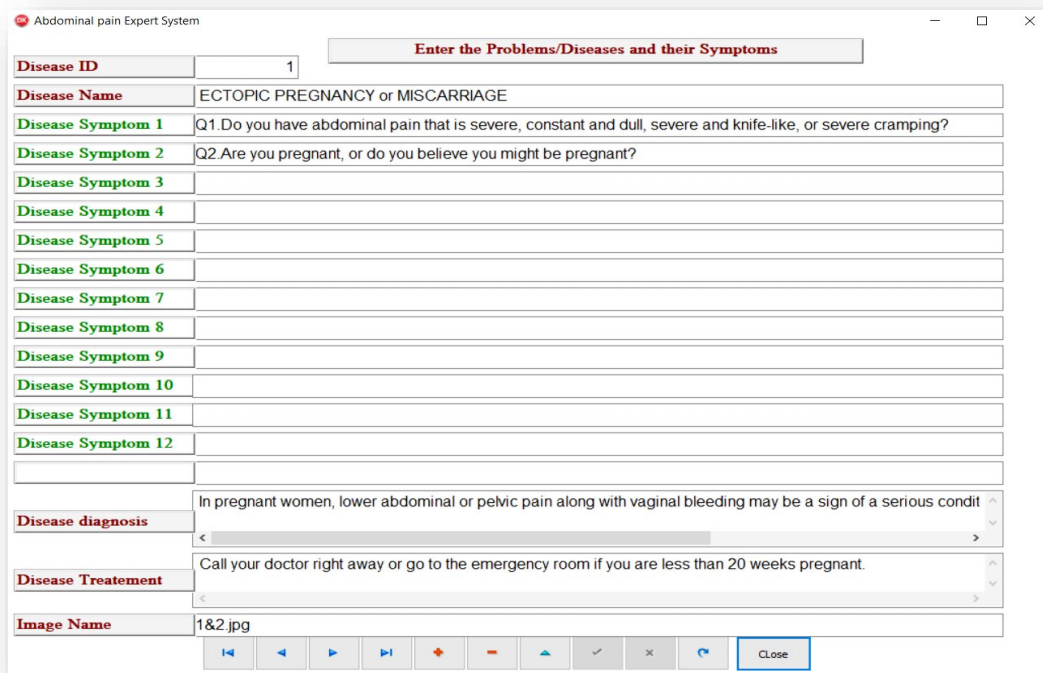


Figure 9 · Entering the problems and their symptoms

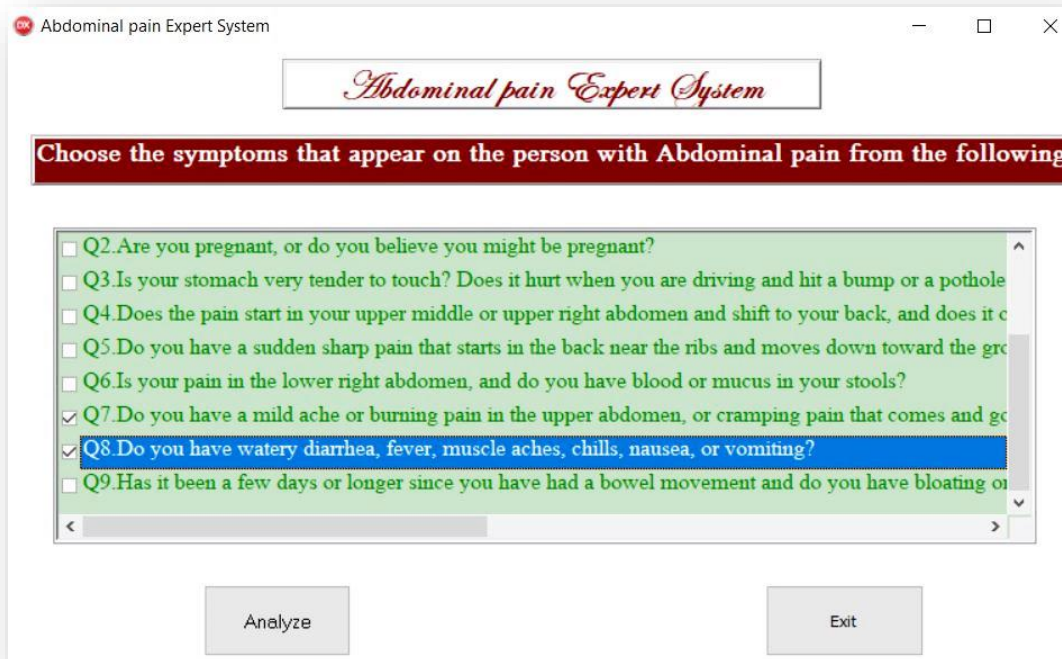


Figure 10 user interface to select the purpose symptoms

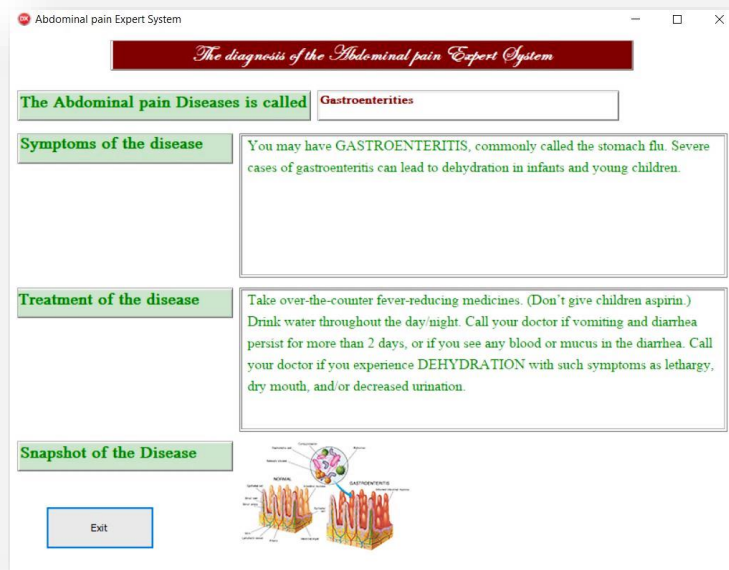


Figure 22 User interface display the details for Abdominal disease

6. LIMITATIONS

Currently the proposed expert system is specialized in the diagnosis Abdominal pain (Stomach Pain), short term: ECTOPIC PREGNANCY OR MISCARRIAGE, APPENDICITIS, DIVERTICULITIS, ULCER, PANCREATITIS, GALLSTONES, INFLAMMATION, KIDNEY STONE, BLADDER INFECTION OR KIDNEY, ULCERATIVE COLITIS OR CROHN'S DISEASE, Gastroenteritis, CONSTIPATION, HEMORRHOID, ANAL FISSURE, PELVIC, INFLAMMATORY DISEASE(PID), CYSTITIS.

7. SYSTEM EVALUATION

As an introductory evolution, a group of Doctors specialists tested this proposed Expert System and they were satisfied with its performance, efficiency, user interface and ease of use. [19]

8. CONCLUSION

In this paper, a proposed expert system was presented for helping Doctor's specialists in diagnosing patients with over ten different possible Abdominal pain (Stomach Pain), short term. Doctors 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 using CLIPS and Delphi languages.

9. FUTURE WORK

This rule-based system was developed to diagnose short-term illnesses. It can be modified (or developed) to diagnose chronic diseases, as it is planned to add more abdominal pain (stomach ache) and make it more accessible to users from anywhere, anytime.

10. EXPERT SYSTEM SOURCE CODE

Abdominal pain (Stomach Pain), short term Expert System

This expert system diagnoses Abdominal pain (Stomach Pain), short term problems

This expert system designed by Marah Al-Masawabwe

```
(defunction ask-question (?question $?allowed-values)
```

```
(printout t ?question)
```

```
(bind ?answer (read))
```

```
(if (lexemep ?answer)
```

```
then (bind ?answer (lowercase ?answer)))
```

```
(while (not (member ?answer ?allowed-values)) do
(printout t ?question)
(bind ?answer (read))
(if (lexemep ?answer)
then (bind ?answer (lowercase ?answer))))
?answer)
```

```
(deffunction ask-num (?question ?a1 ?a2 )
(printout t ?question)
(bind ?answer (read))
(while (or (< ?answer ?a1) (> ?answer ?a2)) do
(printout t ?question)
(bind ?answer (read)) )
?answer)
```

```
(deffunction yes-or-no-p (?question)
(bind ?response (ask-question ?question yes no y n))
(if (or (eq ?response yes) (eq ?response y))
then TRUE
else FALSE))
```

STARTUP RULES

This Rule print a banner message

```
(defrule system-banner ""
(declare (salience 10))
=>
(printout t crlf crlf)
(printout t " Abdominal pain (Stomach Pain), short term Expert System")
(printout t crlf crlf))
```

;;; Rule for printing the final diagnosis and recommendation

```
(defrule print-diagnosis""
(declare (salience 10))
(diagnosis ?item1)
(recommend ?item2)
```

```
=>
(printout t crlf crlf)
(printout t " Diagnosis: " ?item1)
(printout t crlf crlf)
(printout t " recommendation:" ?item2)
(printout t crlf crlf)

(defrule Q1 ""
(not (diagnosis ?))
(not (recommend ?))
(not (Q1 ?))
=>
(if (yes-or-no-p "Q1:Do you have abdominal pain that is severe, constant and dull, severe and knife-like, or severe cramping?")
then (assert (Q1 yes))
else (assert (Q1 no)) ))

(defrule Q1no
(not (diagnosis ?))
(not (recommend ?))
(Q1 no)
=>
(if (yes-or-no-p "Q2:Are you pregnant, or do you believe you might be pregnant? ")
then (assert (Q2 yes))
else (assert (Q2 no)) ))

(defrule Q2no ""
(not (diagnosis ?))
(not (recommend ?))
(Q2 no)
=>
(if (yes-or-no-p "Q3:Is your stomach very tender to touch? Does it hurt when you are driving and hit a bump or a pothole in the road? Do you have bloody diarrhea or stools that are black or tarry? Are you vomiting blood? Do you have a fever, in addition to your abdominal pain?")
then (assert (Q3 yes))
else (assert (Q3 no))))

(defrule Q1yesQ2yes ""
(not (diagnosis ?))
```

(not (recommend ?))

(or(Q1 yes)

(Q2 yes))

=>

(assert (diagnosis "In pregnant women, lower abdominal or pelvic pain along with vaginal bleeding may be a sign of a serious condition, such as ECTOPIC PREGNANCY or MISCARRIAGE."))

(assert (recommend "Call your doctor right away or go to the emergency room if you are less than 20 weeks pregnant. Go to the labor and delivery department if you are over 20 weeks pregnant.")))

(defrule Q3yes ""

(not (diagnosis ?))

(not (recommend ?))

(Q1 no)

(Q2 no)

(Q3 yes)

=>

(assert (diagnosis "These may be signs of a serious problem, such as:APPENDICITIS OR PERFORATED APPENDIX,INFECTIOUS DIARRHEA,DIVERTICULITIS or ULCER,PANCREATITIS,BOWEL BLOCKAGE"))

(assert (recommend "Call your doctor right away or go the hospital.")))

(defrule Q3no

(not (diagnosis ?))

(not (recommend ?))

(Q1 no)

(Q2 no)

(Q3 no)

=>

(if (yes-or-no-p "Q4: Does the pain start in your upper middle or upper right abdomen and shift to your back, and does it occur or worsen when you eat fatty or greasy food?")

then (assert (Q4 yes))

else (assert (Q4 no))))

(defrule Q4yes ""

(not (diagnosis ?))

(not (recommend ?))

(Q1 yes)

(Q1 no)

(Q2 no)

(Q3 no)

(Q4 yes)

=>

(assert (diagnosis "You may have GALLSTONES, an INFECTION, or INFLAMMATION of the gallbladder."))

(assert (recommend "See your doctor right away.")))

(defrule Q4no

(not (diagnosis ?))

(not (recommend ?))

(Q1 no)

(Q2 no)

(Q3 no)

(Q4 no)

=>

(if (yes-or-no-p "Q5:Do you have a sudden sharp pain that starts in the back near the ribs and moves down toward the groin?")

then (assert (Q5 yes))

else (assert (Q5 no))))

(defrule Q5yes ""

(not (diagnosis ?))

(not (recommend ?))

(Q1 no)

(Q2 no)

(Q3 no)

(Q4 no)

(Q5 yes)

=>

(assert (diagnosis "Your pain may be from a KIDNEY STONE or KIDNEY TUMOR. If you have a fever, you may have a KIDNEY or BLADDER INFECTION"))

(assert (recommend "Call your doctor right away or go the hospital.")))

(defrule Q5no ""

(not (diagnosis ?))

(not (recommend ?))

(Q1 no)

(Q2 no)

(Q3 no)

(Q4 no)

(Q5 no)

=>

(if (yes-or-no-p "Q6:Is your pain in the lower right abdomen, and do you have blood or mucus in your stools?")

then (assert (Q6 yes))

else (assert (Q6 no))))

(defrule Q6yes ""

(not (diagnosis ?))

(not (recommend ?))

(Q1 no)

(Q2 no)

(Q3 no)

(Q4 no)

(Q5 no)

(Q6 yes)

=>

(assert (diagnosis "These may be signs of ULCERATIVE COLITIS or CROHN'S DISEASE. These are inflammatory diseases of the colon or large intestine."))

(assert (recommend "See your doctor.")))

(defrule Q6no

(not (diagnosis ?))

(not (recommend ?))

(Q1 no)

(Q2 no)

(Q3 no)

(Q4 no)

(Q5 no)

(Q6 no)

=>

(if (yes-or-no-p "Q7:Do you have a mild ache or burning pain in the upper abdomen, or cramping pain that comes and goes?")

then (assert (Q7 yes))

else (assert (Q7 no))))

(defrule Q7no

(not (diagnosis ?))

(not (recommend ?))

(Q1 no)

(Q2 no)

(Q3 no)

(Q4 no)

(Q5 no)

(Q6 no)

(Q7 no)

=>

(if (yes-or-no-p "Q8:Do you have watery diarrhea, fever, muscle aches, chills, nausea, or vomiting?")

then (assert (Q8 yes))

else (assert (Q8 no)))

(defrule Q7yesQ8yes ""

(not (diagnosis ?))

(not (recommend ?))

(Q1 no)

(Q2 no)

(Q3 no)

(Q4 no)

(Q5 no)

(Q6 no)

(or(Q7 yes)(Q8 yes))

=>

(assert (diagnosis "You may have GASTROENTERITIS, commonly called the stomach flu."))

(assert (recommend "Take over-the-counter fever-reducing medicines.(Don't give children aspirin.) Drink water throughout the day/night. Call your doctor if vomiting and diarrhea persist for more than 2 days, or if you see any blood or mucus in the diarrhea. Call your doctor if you experience DEHYDRATION with such symptoms as lethargy, dry mouth, and/or decreased urination.")))

(defrule Q8no

(not (diagnosis ?))

(not (recommend ?))

(Q8 no)

=>

(if (yes-or-no-p "Q9:Has it been a few days or longer since you have had a bowel movement and do you have bloating or distension of your abdomen? Do you have to strain when you have a bowel movement?")

then (assert (Q9 yes))

else (assert (Q9 no))))

(defrule Q9yes ""

(not (diagnosis ?))

(not (recommend ?))

(Q9 yes)

=>

(assert (diagnosis "CONSTIPATION may be the source of your discomfort. Occasionally a child will hold a bowel movement because of pain from a HEMORRHOID, an ANAL FISSURE, or during potty training."))

(assert (recommend "Be sure to include lots of FIBER in your diet and drink enough fluids. See your doctor if the pain or constipation continues.")))

(defrule Q9no

(not (diagnosis ?))

(not (recommend ?))

(Q9 no)

=>

(if (yes-or-no-p "Q10:Do you have pain or a burning sensation in the upper abdomen that is either relieved or gets worse when you eat? ")

then (assert (Q10 yes))

else (assert (Q10 no))))

(defrule Q10yes ""

(not (diagnosis ?))

(not (recommend ?))

(Q10 yes)

=>

(assert (diagnosis "This may be from GASTRITIS, an irritation of the stomach, or from an ULCER."))

(assert (recommend "Try taking an over-the-counter antacid on a regular basis. See your doctor if an antacid doesn't help, if the pain comes back quickly after taking one, or if you are taking an antacid most days of an average week.")))

(defrule Q10no

(not (diagnosis ?))

(not (recommend ?))

(Q10 no)

=>

(if (yes-or-no-p "Q11:Are you a woman who has a constant pain in the lower abdomen along with a vaginal discharge?")

then (assert (Q11 yes))

else (assert (Q11 no))))

(defrule Q11yes ""

(not (diagnosis ?))

(not (recommend ?))

(Q11 yes)

=>
(assert (diagnosis "A dull, constant pain accompanied by a vaginal discharge may be a sign of PELVIC INFLAMMATORY DISEASE (PID), an infection around your ovaries, uterus, and fallopian tubes."))

(assert (recommend "This condition requires an antibiotic. See your doctor."))

(defrule Q11no

(not (diagnosis ?))

(not (recommend ?))

(Q11 no)

=>

(if (yes-or-no-p "Q12:Do you have a mild pain, discomfort, or a feeling of pressure in the lower abdomen along with a burning sensation when you urinate?")

then (assert (Q12 yes))

else (assert (Q12 no))))

(defrule q12yes ""

(not (diagnosis ?))

(not (recommend ?))

(Q11 no)

(Q12 yes)

=>

(assert (diagnosis "CYSTITIS, an infection of the urinary tract, can be painful and cause abdominal discomfort."))

(assert (recommend "See your doctor promptly."))

(defrule q12no

(not (diagnosis ?))

(not (recommend ?))

(Q11 no)

(Q12 no)

=>

(assert (diagnosis "Unknown "))

(assert (recommend "If the pain doesn't stop within a few hours, call your doctor. For more information, please talk to your doctor. If you think your problem is serious, call right away."))

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