An Expert System for Neck Pain Diagnosis

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Abstract: In fact, people get neck problems due to something such as sports or woke and Wrong sleep habits. In this paper an expert system was designed to help users to correctly diagnose neck problems world (muscle spasm, Muscle aches, Meningitis, herniated cervical disc, Fibromyalgia, Cervical spondylosis, Trigger points) with some information about the disease and self-care. Java language was used to design and implement this expert system.

Keywords: Expert Systems, java, neck Problems, Medical expert system, Artificial Intelligence

I.   Introduction:

Neck pain is a common complaint. Neck muscles can be strained from poor posture whether it's leaning over your computer or hunching over your workbench. Osteoarthritis also is a common cause of neck pain. Rarely, neck pain can be a symptom of a more serious problem. (mayoclinic, 2021) The neck—or cervical spine—is a coordinated network of nerves, bones, joints, and muscles. It has the important job of providing support and mobility for the head, but sometimes it can become painful. There are several problems that cause pain in the neck. Irritation along nerve pathways in the neck can cause pain in the shoulder, head, arm, and/or hand. Additionally, irritation of the spinal cord can cause pain into the legs and other areas below the neck. Neck pain usually goes away within a few days or weeks, but pain that persists for months could signal an underlying medical cause that needs to be addressed. In some cases, early intervention may be necessary for the best results. (pine-health, 2021)

Figure 1 Neck

II.   Expert System

The Expert Systems (ES) are the computer applications developed to solve complex problems in a particular domain, at the level of extra-ordinary human intelligence and expertise, See figure 2 for details.
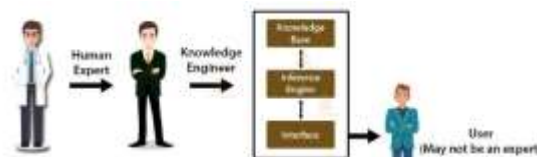

Figure 2 Main of ES Components

Knowledge Base
Contains facts, rules, and objects in domain-specific and high-quality knowledge. Knowledge is required to exhibit intelligence. The success of any ES majorly depends upon the collection of highly accurate and precise knowledge. Obtained from the human expert is prepared by acknowledge engineer as most   human experts are not skilled at computer programming.

Inference Engine
Software that matches the users input with data contained in the knowledge base, the Inference Engine acquires and manipulates the knowledge from the knowledge base to arrive at a particular solution, adds new knowledge into the knowledge base if required. Resolves rules conflict when multiple rules are applicable to a particular case.

User Interface
Show questions to the user and accepts inputs from them the user of the ES need not be necessarily an expert in Artificial Intelligence. The propped Expert System for diagnosis knee problem, was designed and implemented using java**.**

III.   Methods

After running the expert system, user will be answering the questions to answer yes or not only, so the system can then compare the answers with the facts and laws stored in Knowledge Base and give the user the correct Diagnosis and Self Care, Figure 3 shows the decision tree of the expert system for diagnosing the Neck pain.
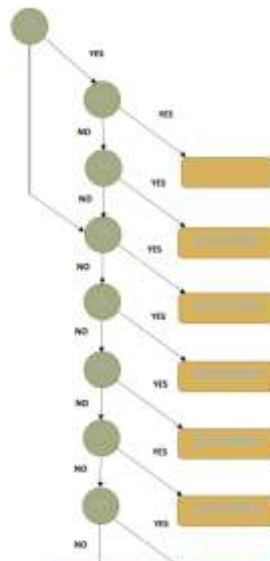

Figure 3 Decision tree of the expert system for diagnosing Neck pain.

IV.   BACKGROUND

Many expert systems have been designed to help facilitating diagnosing and managing a lot of diseases and medical problems which considered as a part of applying Artificial Intelligence and computer science to help doctors, hospitals and health care facilities decision making to enable them to offer their health services in the right way. Some of them are listed below. An Expert System for Knee Problems Diagnosis (F.Samhan, 2021), An Expert System for Mouth Problems in Infants and Children (Naser, 2016), A knowledge-based system for neck pain diagnosis (ALmursheidi, 2016)

Our expert system here is offering an easy way, helping people to know how to diagnose and deal with neck problems. We give a description and Diagnosis for 8 Problems of neck afflicting people around the world (muscle spasm, Muscle aches, Meningitis, herniated cervical disc, Fibromyalgia, Cervical spondylosis, Trigger points) (familydoctor, 2021)

➕ **muscle spasm**

A cervical muscle spasm is a sudden, involuntary contraction of a muscle in the neck in response to strain, overuse, weakness, or trauma. In some cases, a neck spasm may cause the head to turn or jerk without warning, and it may be symptomatic of an injury, such as a fracture, or another disorder. (LOG, 2021)

Figure 4 muscle spasm

♣ MUSCLE ACHES

Neck pain causes include Muscle strains. Overuse, such as too many hours hunched over your computer or smartphone, often triggers muscle strains. Even minor things, such as reading in bed or gritting your teeth, can strain neck muscles. (mayoclinic, Neck pain, 2021)

Figure 5 MUSCLE ACHES

♣ Meningitis

Meningitis is an inflammation of the fluid and membranes (meninges) surrounding your brain and spinal cord. The swelling from meningitis typically triggers signs and symptoms such as headache, fever, and a stiff neck. (mayoclinic, Meningitis, 2021)
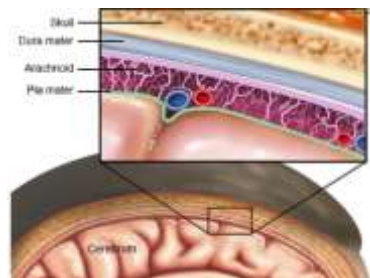

Figure 6 Meningitis

♣ Herniated cervical disc.

A herniated disc occurs when the gel-like center of your disc ruptures out through a tear in the tough disc wall, The gel material is irritating to your spinal nerves, causing something like a chemical irritation. The pain is a result of spinal nerve inflammation and swelling caused by the pressure of the herniated disc. (mayfieldclinic, 2021)

Figure 7   herniated cervical disc.

⬥ Fibromyalgia

If fibromyalgia has caused you to experience pain and stiffness in your neck and shoulders, you may also have frequent headaches. These can vary from being mild headaches to severe migraines, and could also involve other symptoms, such as feeling sick. (spine-health., 2021)
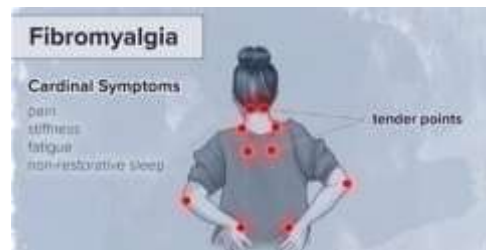

Figure 8   Fibromyalgia

⬥ Cervical spondylosis

Cervical spondylosis is a general term for age-related wear and tear in the cervical spine (neck) that can lead to neck pain, neck stiffness and other symptoms. Sometimes this condition is called arthritis or osteoarthritis of the neck, Cervical spondylosis is the natural wearing down of cartilage, disks, ligaments and bones in your neck. Main symptoms include neck pain or stiffness. Physical therapy; ice, heat, massage; soft collar and drugs are first-to-be-tried approaches. More severe cases, such as herniated disk, bone spurs or pinched nerves, are treated with injections or surgery. (clevelandclinic, 2021)
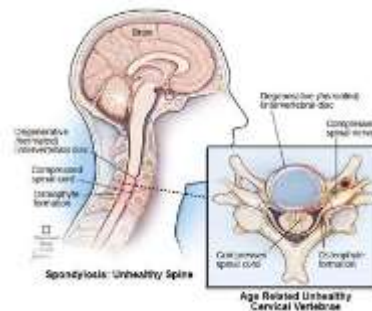

Figure 9   Cervical spondylosis

⬥ 10 Trigger points

Trigger points are raised spots along a band of muscle. They are one of the most common long-term muscle disorders and can affect anyone. TTP occur in the trapezius muscle. This is a very large back muscle that extends from below your shoulder blades, up to your shoulders, and then along the back of your neck. (healthline, 2021)
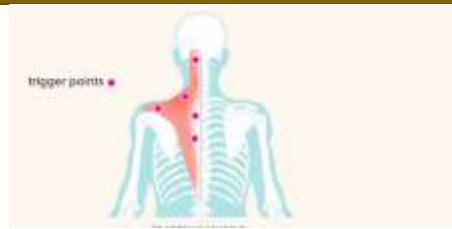
Figure 10 Trigger points

V.   Conclusions and future work

In this paper, a proposed expert system was designed and developed using java language to help doctors, people to find out the cause of their neck problems, quickly and easily. This expert system is simple, fast, and easy to use. We are planning to add more neck problems and creating a mobile app for diagnosing advanced neck problems to provide correct diagnosis and self-care.

VI.   Expert System Source Code:

```java
public static void main(String[] args) {
    // TODO code application logic here
    Scanner s = new Scanner(System.in);
    String a1;
    String a2;
    String a3;
    String a4;
    String a5;
    String a6;
    String a7;
    String a8;
    System.out.println("Wellcome in ");
    System.out.println("neck pain expert system");
    System.out.println("using java");
    System.out.println("By: AMJAD H.FARRA      LAMIS F.SAMHAN      PROF.SAMY ABU NASSER");
```

```java
System.out.println("Q1: Have you had a neck injury?(NOTE: ANSWER YES OR NO)");
a1 = s.next();
if ("yes".equals(a1)) {
    System.out.println("Q4: Do you have a fever, stiff neck, vomiting, and do normal amounts of light hurt your eyes?");
    a4 = s.next();
if ("no".equals(a4)) {
    System.out.println("Q5: Do you have throbbing pain or numbness down your shoulder or into your arm?");
    a5 = s.next();
if ("no".equals(a5)) {
    System.out.println("Q6: Do you have a stiff neck or are you having trouble moving your neck without pain?");
    a6 = s.next();
if ("no".equals(a6)) {
    System.out.println("Q7: Did you have a whiplash-type injury in the past, or do you have pain and/or stiffness every day in    your neck, hands, !
    a7 = s.next();
if ("no".equals(a7)) {
    System.out.println("Q8: Do you feel a tender point or knot in your neck or upper shoulders that has associated pain into your neck or even assoc
    a8 = s.next();
if ("no".equals(a8)) {
    System.out.println("SEE THE DOCTOR");
}if ("yes".equals(a8)) {
    System.out.println("These are known as TRIGGER POINTS and occur often with people that type or write for work."
        + "");
    System.out.println("SELF CARE:\n" +"            Provide good forearm support when typing and writing. Arm rests can help, or have the keyboard
        + "");
    }
    }if ("yes".equals(a7)) {
    System.out.println("Your pain may be from CERVICAL OSTEOARTHRITIS (CERVICAL SPONDYLOSIS), a disorder that affects the bones and cartilage in the
    System.out.println("SELF CARE:\n" +"            Use anti-inflammatory medicines, such as ibuprofen or acetaminophen. See your doctor if the pa
    }
```

```java
}if ("no".equals(a1)) {
    System.out.println("Q2: Are you having pain or numbness that extends from your neck down your shoulder, arms, or legs?");
    a2 = s.next();
if ("no".equals(a2)) {
    System.out.println("Q3: Has pain come on slowly over a few hours after the accident or injury?");
    a3 = s.next();
if ("no".equals(a3)) {
    System.out.println("Q4: Do you have a fever, stiff neck, vomiting, and do normal amounts of light hurt your eyes?");
    a4 = s.next();
if ("no".equals(a4)) {
    System.out.println("Q5: Do you have throbbing pain or numbness down your shoulder or into your arm?");
    a5 = s.next();
if ("no".equals(a5)) {
    System.out.println("Q6: Do you have a stiff neck or are you having trouble moving your neck without pain?");
    a6 = s.next();
if ("no".equals(a6)) {
    System.out.println("Q7: Did you have a whiplash-type injury in the past, or do you have pain and/or stiffness every day in   your neck, hands, 1
    a7 = s.next();
if ("no".equals(a7)) {
    System.out.println("Q8: Do you feel a tender point or knot in your neck or upper shoulders that has associated pain into your neck or even asso
    a8 = s.next();
if ("no".equals(a8)) {
    System.out.println("SEE THE DOCTOR");
}if ("yes".equals(a8)) {
    System.out.println("These are known as TRIGGER POINTS and occur often with people that type or write for work."
        + "");
    System.out.println("SELF CARE:\n" +"               Provide good forearm support when typing and writing. Arm rests can help, or have the keyboard
        + "");
}}if ("yes".equals(a7)) {
    System.out.println("Your pain may be from CERVICAL OSTEOARTHRITIS (CERVICAL SPONDYLOSIS), a disorder that affects the bones and cartilage in the
    System.out.println("SELF CARE:\n" +"               Use anti-inflammatory medicines, such as ibuprofen or acetaminophen. See your doctor if the pa
    }
```

```java
    }
    }if ("yes".equals(a7)) {
    System.out.println("Your pain may be from CERVICAL OSTEOARTHRITIS (CERVICAL SPONDYLOSIS), a disorder that affects the bones and cartilage in the
    System.out.println("SELF CARE:\n" +"               Use anti-inflammatory medicines, such as ibuprofen or acetaminophen. See your doctor if the pa
    }



    }if ("yes".equals(a6)) {
    System.out.println("Your pain is probably from MUSCLE SPASM, but also may be from RHEUMATOID ARTHRITIS, an inflammatory joint disease, or FIBROMY
        + " ");
    System.out.println("SELF CARE:\n" +"               Use anti-inflammatory medicines, such as ibuprofen or aspirin, and apply heat to the sore area
        + " ");
    }



    }if ("yes".equals(a5)) {
    System.out.println("You may have a HERNIATED CERVICAL DISC, when part of the cushioning part of the bony spine presses backward against a nerve.
    System.out.println("SELF CARE:\n" +"               See your doctor. Use over-the-counter medicine, such as acetaminophen or ibuprofen, to relieve pain,
    }


    }
if ("yes".equals(a4)) {
    System.out.println("Your symptoms may be from a simple viral illness or from MENINGITIS, a more serious infection   around the brain.");
    System.out.println("SELF CARE:\n" +"    EMERGENCY\n" +"   See your doctor or go to the emergency room right away.");
    }

    }if ("yes".equals(a6)) {
    System.out.println("Your pain is probably from MUSCLE SPASM, but also may be from RHEUMATOID ARTHRITIS, an inflammatory joint disease, or FIBRO
        + " ");
    System.out.println("SELF CARE:\n" +"               Use anti-inflammatory medicines, such as ibuprofen or aspirin, and apply heat to the sore are
        + " ");
    }

    }if ("yes".equals(a5)) {
    System.out.println("You may have a HERNIATED CERVICAL DISC, when part of the cushioning part of the bony spine presses backward against a nerve
    System.out.println("SELF CARE:\n" +"               See your doctor. Use over-the-counter medicine, such as acetaminophen or ibuprofen, to relieve pain
    }

    }
    if ("yes".equals(a4)) {
    System.out.println("Your symptoms may be from a simple viral illness or from MENINGITIS, a more serious infection   around the brain.");
    System.out.println("SELF CARE:\n" +"    EMERGENCY\n" +"   See your doctor or go to the emergency room right away.");
    }

    }if ("yes".equals(a2)) {
    System.out.println("       This may be MUSCLE SPASM or a BURNER, but it also may be an injury to the SPINAL CORD.");
    System.out.println("SELF CARE:\n" +"    EMERGENCY\n" +"   See your doctor or go to the emergency room right away. If your doctor diagnoses you
    }
}else{System.out.println("error! try again");}
}
```

code test:

```
run:
Wellcome in
neck pain expert system
using java
By: AMJAD H.FARRA       LAMIS F.SAMHAN      PROF.SAMY ABU NASSER
Q1: Have you had a neck injury?(NOTE: ANSWER YES OR NO)
yes
Q4: Do you have a fever, stiff neck, vomiting, and do normal amounts of light hurt your eyes?
yes
Your symptoms may be from a simple viral illness or from MENINGITIS, a more serious infection   around the brain.
SELF CARE:
     EMERGENCY
     See your doctor or go to the emergency room right away.
BUILD SUCCESSFUL (total time: 5 seconds)
```

```
run:
Wellcome in
neck pain expert system
using java
By: AMJAD H.FARRA       LAMIS F.SAMHAN      PROF.SAMY ABU NASSER
Q1: Have you had a neck injury?(NOTE: ANSWER YES OR NO)
no
Q2: Are you having pain or numbness that extends from your neck down your shoulder, arms, or legs?
no
Q3: Has pain come on slowly over a few hours after the accident or injury?
no
Q4: Do you have a fever, stiff neck, vomiting, and do normal amounts of light hurt your eyes?
no
Q5: Do you have throbbing pain or numbness down your shoulder or into your arm?
no
Q6: Do you have a stiff neck or are you having trouble moving your neck without pain?
no
Q7: Did you have a whiplash-type injury in the past, or do you have pain and/or stiffness every day in    your neck, hands, knees, hips, or other joints?
no
Q8: Do you feel a tender point or knot in your neck or upper shoulders that has associated pain into your neck or even associated with your temple and head?
no
SEE THE DOCTOR
BUILD SUCCESSFUL (total time: 25 seconds)
```

Code error:

```
run:
Wellcome in
neck pain expert system
using java
By: AMJAD H.FARRA       LAMIS F.SAMHAN      PROF.SAMY ABU NASSER
Q1: Have you had a neck injury?(NOTE: ANSWER YES OR NO)
aaaaaa
error: try again
BUILD SUCCESSFUL (total time: 20 seconds)
```

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