Lower Back Pain Expert System Diagnosis And Treatment

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Abstract— **Lower Back Pain (LBP) is one of the common problems encountered in medical applications. LBP can be caused by quite a few problems in any parts of the complicated, interrelated set of connections of the spinal muscles, nerves, bones, discs or tendons in the lumbar spine. Classical sources of LBP take account of: the bulky nerve roots in the low back that go to the legs may be aggravated, the smaller nerves that supply the low back may be aggravated, the great paired lower back muscles can be stressed, the bones, ligaments or joints can be dented, and an intervertebral disc may be deteriorated.**
This paper proposes an expert system that can be used to successfully diagnose low back pain intensity. The suggested systems were found to be advantageous approach in addition to existing unbiased ones. So far as the authors are aware, this is the first attempt of using an expert system in achieving very good performance in a real world application. In light of some of the limitations of this study, we also identify and discuss several areas that need continued investigation. SL5 Object language was used designing the proposed expert system.

Keywords— **Artificial Intelligence, Expert Systems, SL5 Object, Lower Back Pain**

I. INTRODUCTION

Low back pain is a general anarchy concerning the muscles, nerves, and bones of the back [9]. Ache can vary from a tedious steady ache to a unexpected pointed sentiment[9]. Low back pain can be classified by the extent of pain (pain lasting less than 6 weeks), sub-chronic (6 to 12 weeks), or chronic (more than 12 weeks)[10]. The condition can be further classified by the fundamental cause as either perfunctory, non-perfunctory, or called ache[11]. The symptoms of low back pain typically get better within a small number of weeks from the time they begin, with 41-90% of people absolutely better by six weeks[12].

In most episodes of low back pain, a precise fundamental cause is not acknowledged or even looked for, with the pain thought to be due to perfunctory problems such as muscle or joint sprain [13][9] . If the pain does not depart with conventional treatment or if it is coincide with red flags such as

unjustified weight loss, fever, or considerable problems with reaction or movement, additional testing can be required to look for severe fundamental problem[11]. In the majority of cases, imaging tools such as X-ray computed tomography are not practical and hold their own risks [14][15]. Even though, the use of imaging in low back pain has gowned[16]. Various low back pain is caused by wronged intervertebral discs, and the direct leg lift up test is helpful to recognize this cause [11]. People with constant pain, the pain dispensation system may fail, causing large amounts of pain in reply to non-serious actions [17]. For all the above mentioned reasons, we have developed this expert system to assist Physician in diagnosing lower back pain in order to recommend the appropriate treatment.

Expert Systems: An Expert System is a computer application of Artificial Intelligence (AI) [2, 4, 6]; which contains a user interface, explanation subsystem, a knowledge base and an inference engine[3]; the main component of an expert system is clearly shown in figure 1.
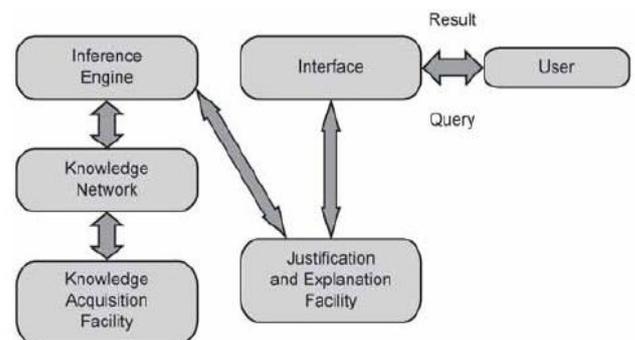

Fig. 1: Main Components of an Expert System.

The propped Expert System for Lower Back Pain Diagnosis was implemented using SL5 Object language which stands for Simpler Level 5 Object[7]. It is a forward chaining expert system that can make inferences about facts of the world using rules, objects and take appropriate actions as a result. The SL5 Object language is implemented in Delphi Embarcadero RAD Studio XE6[8]. SL5 Object language is easy for the knowledge engineer to build the Expert System and for the end users when they use the system.

II.   LITERATURE REVIEW

There are many Expert System that were designed to diagnose diseases[20-27]. But there is no special system for diagnosis of the Lower Back Pain available. Although it's linked to several human diseases such as: Diabetes, Skin, bacterial, Ear, Eye, Mouth Problems, Neck problems [1,20-30]. Talayeh developed an expert system for diabetes diagnosis[5]. MYCIN is a famous expert system for diagnosing bacterial infections[6]. Some of these Expert Systems are specialized in one specific disease and other in a few diseases. However, the current proposed expert system is specialized in the diagnosis of Lower Back Pain.

III.   MATERIALS AND METHODS

The proposed expert system perform diagnosis for the Lower Back Pain of all stages of the life of human starting with newly born to the elderly by asking questions that requires yes or no answers. The proposed expert system will ask the user to choose the correct answer in each frame. At the end of the diagnosis session, the proposed expert system provides diagnosis of the problem and recommendation of the Pain to the users. Figure 2 shows an example of yes/no question and Figure 3 shows how the expert system displays diagnosis of the problem and recommendation.

Fig2: Shows when the system asks users.

Fig3: Shows when the system provides diagnosis and recommendation

IV.   KNOWLEDGE REPRESENTATION

The main sources of the knowledge for this expert system are Physician and specializes websites for Lower Back Pain. The captured knowledge have been converted into SL5 Object Knowledge base syntax (Facts, Rules and Object). Currently the expertsystem has 10rules which cover Lower Back Pain.

The core cause of the lower back pain may be a problem with the back itself or by a problem in a different part of the body. In numerous cases, physician may not discover a cause for the ache. When a cause is recognized, general explanations take account of[18,19]:

• Pressure or damage concerning the back muscles, as well as back wrench or twist; constant excess of back muscles attributed to obesity; and temporary excess of back muscles attributed to any unusual pressure, such as carrying heavy things or pregnancy.

• Illness or damage connecting the back bones, together with fracture from an adversity or in consequence of the bone-thinning disease osteoporosis.

• Disintegrative arthritis, a wear and tear track that can be connected to age, injury and genetic predilection.

• Illness or damage related to the spinal nerves, in addition to nerve injury attributable to a protruding disk (a fibrous pillow among vertebrae) or spinal stenosis (a reduction of the spinal tube).
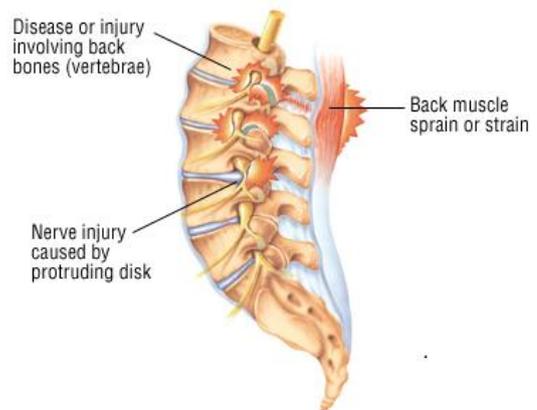
Fig4: Shows some of the diseases of lower back pain

• Kidney stones or a kidney infectivity (pyelonephritis).

• Inflammatory arthritis, as well as ankylosing spondylitis and associated conditions.

• A spinal tumor or a cancer that has stretch to the spine from somewhere else in the body.

• Infection, which can be in the disk space, bone (osteomyelitis), stomach, pelvis or blood stream.

V. SYMPTOMS OF LOWER BACK PAIN

Signs and symptoms of back pain may comprise[18,19]:

- Muscle pain

- Shooting or stabbing pain

- Pain that spread out down your leg

- Restricted flexibility or range of movement of the back

VI. RISK FACTORS OF LOWER BACK PAIN

Anybody can get back pain, even kids and youth. Researchers did not prove what contributes to back pain yet. Nonetheless, these factors may put you at superior risk of emergent back pain[18,19]:

- Age. Back pain is more widespread as you get older, starting approximately at age 31 or more.

- Lack of exercise. Weak, unused muscles in your back might lead to back pain.

- Excess weight. Lifting too much weight puts extra pressure on your back.

- Diseases. Several types of arthritis and cancer may donate to back pain.

- Improper lifting. Using your back as a substitute of your legs may guide to back pain.

- Psychological conditions. People prone to sadness and worry seem to have a bigger risk of back pain.

- Smoking. This may keep your body from sending enough food to the disks in your back.

VII. SYSTEM EVALUATION

A preliminary evaluation was carried out to test the Lower back pain expert system. A group of students in Medicine College voluntarily accepted to participate in testing the expert system. They were satisfied with the performance of the proposed Expert System and they were comfortable using the system.

VIII. CONCLUSION

In this paper, a proposed expert system was presented for adding Physicians in diagnosing patients with possible Lower Back Pain. Physicians and Lower Back Pain patients can get the diagnosis faster and more accurate than the traditional diagnosis done by physicians. This expert system does not require rigorous training to be used; it has a straightforward and user friendly interface. It was developed using SL5 Object expert system language. The results of the preliminary testing of the expert system was promising.

IX. FUTURE WORK

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

X. EXPERT SYSTEM SOURCE CODE:

```
! Lower Back Pain Expert System
! Written By Rami AlDahdooh
                    !
ATTRIBUTE One Did your pain begin after a fall or
injury or when you lifted an object COMPOUND
Yes, No
ATTRIBUTE Two Do you have numbness or pain
extending down your leg COMPOUND Yes, No
ATTRIBUTE Three Are you over 60 years of age or
do you have arthritis and are you having severe pain
COMPOUND  Yes, No
ATTRIBUTE Five Do you have pain that comes and
goes that may have started in your teen years
COMPOUND  Yes, No
ATTRIBUTE Four Do you have pain when twisting
bending or even sitting COMPOUND  Yes, No
ATTRIBUTE Six Do you have a fever COMPOUND
Yes, No
ATTRIBUTE Seven Do you have blood in your urine
and one sided back pain along with burning during
urination COMPOUND  Yes, No
ATTRIBUTE Eight Is your back stiff and sore in the
morning and are other joints stiff sore swollen or red
COMPOUND  Yes, No
ATTRIBUTE Nine Are you pregnant COMPOUND
Yes, No
ATTRIBUTE Ten Is the pain centered in the lower
spine and do you have pain down your leg
COMPOUND Yes, No

ATTRIBUTE start SIMPLE

INSTANCE the domain ISA domain
  WITH start := TRUE

INSTANCE the application ISA application
 WITH title display := introduction
 WITH conclusion display :=Conc
 WITH numeric precision := 8
 WITH simple query text := "
* of  *"
WITH numeric query text := "What is the value of :
* of  *"
WITH string query text := "What is(are):
* of  *"
WITH time query text := "What is(are):
*of  *"
WITH interval query text := "What is(are):
*of  *"
WITH compound query text := "
 *? of  *"
WITH multicompound query text := "What is(are):
 * of  *"

INSTANCE introduction ISA display
```

WITH wait := TRUE
WITH delay changes := FALSE
WITH items [1] := textbox 1

INSTANCE textbox 1 ISA textbox
  WITH location := 10,10,800,350
  WITH pen color := 0,0,0
  WITH fill color := 100,200,100
  WITH justify IS left
  WITH font := "Arial"
  WITH font style IS bold
  WITH font size := 14
  WITH text :="   Lower Back Pain Expert System
Diagnosis & Treatment

        Written By Rami AlDahdooh

This Expert system is written using Simpler Level 5
Object (SL5 Object) that
uses some of the System classes, Instances, Rules,
etc.

This Expert System diagnoses Lower Back Pain
through a dialogue between the
Expert System and the End User.

The Conclusion of the finding is displayed and a
recommendation is given for the End User
As a diagnoses of the diseases."

INSTANCE Conc ISA display
  WITH wait := TRUE
  WITH delay changes := FALSE
  WITH items [1] := title textbox
  WITH items [2] := diagnosis textbox
  WITH items [3] := recommend textbox
INSTANCE title textbox ISA textbox
  WITH location := 20,10,800,70
  WITH pen color := 0,0,0
  WITH fill color := 200,200,100
  WITH justify IS center
  WITH font := "Arial"
  WITH font style IS bold
  WITH font size := 14
  WITH text := " Lower Back Pain Expert System
Diagnosis & Treatment"

INSTANCE diagnosis textbox ISA textbox
  WITH location := 20,110,800,130
  WITH pen color := 0,0,0
  WITH fill color := 170,170,170
  WITH justify IS left
  WITH font := "Arial"
  WITH font size := 12
  WITH text :=" "

INSTANCE recommend textbox ISA textbox
  WITH location := 20,280,800,130
  WITH pen color := 0,0,0
  WITH fill color := 170,170,170
  WITH justify IS left
  WITH font := "Arial"

  WITH font size := 12
  WITH text := " "

RULE R0
IF start
THEN ASK One Did your pain begin after a fall or
injury or when you lifted an object

RULE R1
IF One Did your pain begin after a fall or injury or
when you lifted an object IS Yes
THEN ASK Two Do you have numbness or pain
extending down your leg
ELSE ASK Five Do you have pain that comes and
goes that may have started in your teen years

RULE R2
IF Two Do you have numbness or pain extending
down your leg IS No
THEN ASK Three Are you over 60 years of age or do
you have arthritis and are you having severe pain
ELSE
text OF diagnosis textbox := " You may have a
HERNIATED DISK."
AND text OF recommend textbox := " See your
doctor. Get plenty of rest and use an anti-
inflammatory medicine to relieve pain. If your pain is
severe,
if you have lost feeling or movement, or if you have
lost control of your bladder or bowels, see your doctor
or go to the emergency room right away. "

RULE R3
IF Three Are you over 60 years of age or do you have
arthritis and are you having severe pain IS No
THEN ASK Four Do you have pain when twisting
bending or even sitting
ELSE text OF diagnosis textbox := " You may have a
FRACTURED SPINE."
AND text OF recommend textbox := " EMERGENCY
Call an ambulance right away.
Do not try to drive to the emergency room, and try to
move as little as possible. "

RULE R4
IF Four Do you have pain when twisting bending or
even sitting IS No
THEN ASK Five Do you have pain that comes and
goes that may have started in your teen years
ELSE text OF diagnosis textbox := " Your pain may be
from MUSCLE SPASM, a PULLED MUSCLE or a
HERNIATED DISK."
AND text OF recommend textbox := " Apply heat, use
an anti-inflammatory medicine and get rest.
If you don't get better or if your symptoms get worse,
see your doctor."

RULE R5
IF Five Do you have pain that comes and goes that
may have started in your teen years IS No
THEN ASK Six Do you have a fever

ELSE text OF diagnosis textbox := " You may have SPONDYLOLISTHESIS, when one vertebra in the spine slips over another, or SPONDYLOSIS, a type of arthritis."
AND text OF recommend textbox := " See your doctor. Use anti inflammatory medicines to relieve pain."

RULE R6
IF Six Do you have a fever IS Yes
THEN ASK Seven Do you have blood in your urine and one sided back pain along with burning during urination
ELSE ASK Eight Is your back stiff and sore in the morning and are other joints stiff sore swollen or red

RULE R7
IF Seven Do you have blood in your urine and one sided back pain along with burning during urination IS No
THEN text OF diagnosis textbox := " You may have a viral illness such as the FLU."
AND text OF recommend textbox := " Use analgesics such as acetaminophen to reduce fever and use over-the-counter cold medicines to treat other symptoms. See your doctor if your symptoms don't improve or if they get worse."
ELSE text OF diagnosis textbox := " You may have a kidney infection such as PYELONEPHRITIS. You may also have KIDNEY STONES,
which can start a kidney infection and may cause pain, blood and painful urination without a fever."
AND text OF recommend textbox := " URGENT See your doctor right away."

RULE R8
IF Eight Is your back stiff and sore in the morning and are other joints stiff sore swollen or red IS No
THEN ASK Nine Are you pregnant
ELSE text OF diagnosis textbox := " You may have ANKYLOSING SPONDYLITIS, a form of arthritis that affects the spine.
Other forms of ARTHRITIS can also cause back pain."
AND text OF recommend textbox := " Use an anti-inflammatory medicine and apply heat to the affected area. If you do not improve, or if your pain is severe or gets worse, see your doctor."

RULE R9
IF Nine Are you pregnant IS No
THEN ASK Ten Is the pain centered in the lower spine and do you have pain down your leg
ELSE text OF diagnosis textbox := " PREGNANCY causes stretching of the ligaments
around the uterus and pressure on the lower back."
AND text OF recommend textbox := " Apply mild heat to the back only.
See your doctor if the pain continues or if fever or bleeding accompanies the pain."

RULE R10

IF Ten Is the pain centered in the lower spine and do you have pain down your leg IS No
THEN text OF diagnosis textbox := " ------ "
AND text OF recommend textbox := " For more information, please talk to your doctor.
If you think the problem is serious, call your doctor right away."
ELSE text OF diagnosis textbox := " You may have a HERNIATED DISK or SPINAL STENOSIS."
AND text OF recommend textbox := " See your doctor. Get plenty of rest and use an anti-inflammatory medicine to relieve pain. If your pain is severe, if you have lost feeling or movement, or if you have lost control of your bladder or bowels, see your doctor or go to the emergency room right away."

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