

Application of Low Back Pain Myogenic Therapy Based on Multimedia

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Abstract—Low back pain restricts activity and causes work absenteeism. Cases of low back pain are common worldwide. This paper presents the design of multimedia-based low back pain myogenic therapy aids. Data collection involves observation and interviews with medical rehabilitation specialists and physiotherapists. The collected data is represented using a production ruler in the form of if - then. Rule-based reasoning can be used as an expert system knowledge base in cases of myogenic low back pain. Forward chaining can be used as an inference engine for similar cases because the reasoning starts from the facts section before reaching the hypothesis. Design of this assistive device model is expected to provide information regarding the choice of therapy for low back pain myogenic by patients, independently at home or with the help of close family. Application design is multimedia-based to make it easier for users to look at examples visually. The expert system application is well accepted by users. Ten physiotherapists and one doctor consider the application performance good because it attains an acceptable value of 0.80 or 80%. The physiotherapists suggest that this assistive device model will likely increase the intensity of therapy because it can be carried out by the patient's family independently.

Keywords: multimedia application, low back pain, myogenic, design, therapy

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1. Introduction

Low back pain (LBP) is an activity restrictions and work absenteeism. It is a health problem that very common worldwide [1], [2]. Low back pain does not cause death, but causes individuals becoming unproductive [3]. Since the mid-1990s, the incidence of back pain in the UK has increased by 12.7% and outpatient visits for back pain are then five times greater [4]. In the United States, 80% of the population has complained of low back pain. This complaint is the second most common after headache. In fact, low back pain is the third most common cause of disability in the United States [5].

Low back pain myogenic is an unpleasant sensory and emotional experience in the area between the 12th thoracic vertebra to the lower part of the hip or anal canal [6], [7]. It may result in potential damage or tissue damage, such as vascular dermis, fascia, muscle, tendon, cartilage, bone, ligament, intra-articular meniscus, bursa [8].

Back pain disorder in this research is a part of post-pain rehabilitation. Before using the tool, developed in this research, the patient and the patient's family are advised to consult with a medical rehabilitation specialist, to ensure the patient's condition. This paper provides some examples

of motion simulation for healing. Medical record data processing will be used in the input and output processes of the multimedia application. Rule based reasoning is used to process the input to produce an output in the form of the right therapeutic solution.

An expert system is a system that seeks to adopt human knowledge to computers, so that computers can solve problems as usually done by experts. The structure of the expert system is divided into two environment, the development environment and consulting environment [9]. Decision support system applications (Expert Systems) use data, provide an easy user interface (user friendly), and can incorporate the thoughts of decision makers. The user interface is one of the important supporting components in building a decision support system or expert system.

The expected objectives of this research are as follows:

- 1) Educate the public about low back pain myogenic
- 2) Provide information related to the choice of therapy for low back pain myogenic by patients and families

Application of multimedia-based aids produced in this research

- 1) Can be used as a means of information for the community.

- 2) Early detection of low back pain disorders in general.
- 3) In order to avoid more severe back problems.
- 4) Helping low back pain patients in general to do independent therapy at home or with the help of close family.

a. Low Back Pain Therapy

Back Exercise is an exercise that is used to restore the strength, endurance and flexibility of the back muscles [5]. Its purpose is to reduce body pressure on the facets and stretch the lumbar region muscles and correct body malformations. The exercise program includes everything about the dose of exercise, the frequency of exercise, the time of exercise, and other training principles [10], [11]. This training program is structured systematically, measurably, and adapted to the training objectives needed. Physical exercise requires a relatively long time to get optimal results. The results of physical exercise are not something that can be obtained instantly, in one or two week.

b. Multimedia Applications in the World of Health

Multimedia applications that are considered suitable for hospital needs are applications that can respond and provide information needed by patients, besides that patients can also choose the type of information they want, in this case that includes the above criteria is a CD interactive, as a medium for delivering information with an informative and attractive appearance. The provision of the information center provided must be really considered because the ease of obtaining information will provide understanding [12].

2. Methods

This Research used R&D method. Data was collected through observation, interview with medical rehabilitation specialists and physiotherapists. The result of collecting data used to produce the rule in the form of **if-then**. A decision table was created then converted into production rules [5].

The mechanism of the forward chaining system begins by entering a set of known facts into working memory, then matching these facts with the IF part of the IFTHEN rules. If there are facts that match the IF part, then the rule is executed. When a rule is executed, a new fact (the THEN part). Each time a match, starting from the top rule. Each rule can only be executed once. The matching process stops when there are no more rules that can be executed or have reached the goal or there are no more rules whose premise matches the known facts. The form of representation of Rule Based Reasoning is used because it has a certain amount of expert knowledge on a particular problem and the expert can solve the problem systematically and sequentially. A rule-based representation that has an **if** condition/premise then action/conclusion pattern in an expert table will provide benefits in various aspects, including easy modification, whether changing

data, adding data or deleting data. In this case, **“if”** can be represented as symptoms felt by the patient and **“then”** in the form of solutions achieved.

The system design method used is based on Rule-based Reasoning. By using the step of modifying the source of knowledge from experts so that it can be implemented into a rule-based design. The knowledge is then grouped based on the diagnosis step, then tabulated and given a special code to make it easier to carry out the process of forming rules. The code will represent the implementation process. From the results of medical record data processing, knowledge can be obtained, from this knowledge, for the case of diagnosing muscle strength in this research, a decision tree can be used as can be seen in Figure1. The description of the decision tree is presented in Table 1.



Figure 1. Decision Tree

Table 1. Decision Tree Description

No	Code	Information
1	A1	Does the patient have movement disorders?
2	B1	normal patient
3	A2	Does the patient have a fever above 38°C?
4	B2	Cannot be treated with this assistive model, because the patient has symptoms of high fever which may have more serious consequences. (consult doctor)
5	A3	Does the patient have difficulty urinating?
6	B3	Cannot be treated with this assistive model, because the patient has symptoms of difficulty urinating, which may have more serious consequences. (consult doctor)

No	Code	Information
7	A4	Does the patient experience symptoms of weight loss without knowing the cause?
8	B4	Cannot be treated with this assistive model, because there are symptoms of losing weight without knowing the cause. (consult doctor)
9	A5	Does the patient have back pain that doesn't go away after you lie down?
10	B5	Cannot be treated with this assistive model, because the patient experiences back pain symptoms that do not subside after the patient lies down. (consult doctor)
11	A6	Does the patient have chest pain?
12	B6	Cannot be treated with this assistive model, because the patient experiences chest pain. (consult doctor)
13	A7	Does the patient have pain in one or both legs, especially if the pain radiates down to the knee?
14	B7	Cannot be treated with this assistive device model, because the patient has symptoms of pain in one or both legs, especially if the pain radiates below the knee. (consult doctor)
15	A8	Does the patient have pain that gets worse at night?
16	B8	Cannot be treated with this assistive model, because the patient has pain symptoms that get worse at night. (consult doctor)
17	A9	Is the patient unable to hold urination and defecation?
18	B9	Cannot be treated with this assistive device model, because in the sand there are symptoms of not being able to hold urination and defecation. (consult doctor)
19	A10	Does the patient experience numbness in the genital area, buttocks, or back?
20	B10	Cannot be treated with this assistive model, because the patient has several symptoms of numbness in the genital area, buttocks, or back of the body. (consult doctor)
21	A11	Does the patient have swelling and redness on the back?
22	B11	Cannot be treated with this assistive model, because the patient has symptoms of swelling and redness on the back. (consult doctor)
23	A12	Does the patient have posture problems?
24	S1	There is a possibility that the patient's low back pain includes mild low back pain, one of the causes is due to kyphosis posture disorders, so the patient can heal with special movement therapy for kyphosis sufferers.
25	A13	Does the patient have kyphosis?
26	S2	There is a possibility that the patient's low back pain includes mild low back pain, one of the causes is due to a lordosis posture disorder, so the patient can heal with special movement therapy for lordosis sufferers.
27	A14	Does the patient have a lordotic disorder?

No	Code	Information
28	S3	There is a possibility that the patient's low back pain includes mild low back pain, one of the causes is due to scoliosis posture disorders, so the patient can heal with special movement therapy for scoliosis sufferers.
29	A15	Does the patient have scoliosis?
30	S4	There is a possibility that the patient's low back pain includes mild low back pain and the patient also does not have an abnormal posture so that the patient can heal with therapeutic movements.

a. Interface Implementation

In this application, the "intro" page, Figure 2, is the opening page before entering the "home" page, Figure 3, which contains the title "Dangerous Low Back Pain Therapy Application Multimedia-Based" then there is a "Start" button to start using the application



Figure 2. Intro menu



Figure 3. Home menu

The "home" page consists of three main menus, namely "system information", "bone abnormalities info", and "case & therapy examples". The "system information" button is used to move to the "system description" page. The "info bone disorder" page is used to move to the "muscle strength information" page which contains 3 kinds of pictures of bone disorders and their descriptions. The "case & therapy example" button is the main module of the expert system created in this study.

b. Information Menu

The "information" page, Figure 4, will appear when the user selects the "system information" menu on the

“home” page. This menu provides information of the purpose of this application.



Figure 4. Information menu

c. Menu of the Bone Abnormalities Info

The “Info Bone Disorders” page will appear when the user selects the menu “Info Bone Abnormalities” on the “home” page. This menu provides the information of bone disorders, namely Kyphosis, Lordosis and Scoliosis along with their descriptions. The interface for the “Bone Abnormalities information” page can be seen in Figure 5.



Figure 5. Bone disorder information page

d. Expert System Testing The expert

The application is expected to produce output in accordance with the decision tree. Testing the expert system was performed by testing all existing structured questions. The structured questions include:

- 1) Does the patient have limb disorders?
If yes then proceed to the next structured question (valid)
If no then the patient is declared normal (valid)
- 2) Does the patient have a fever above 38°C?
If yes, then it cannot be treated with this assistive model, because the patient has symptoms of high fever which may have more serious consequences. consult a doctor (valid)
If not then proceed to the next structured question (valid)
- 3) Does the patient have difficulty urinating?
If yes, then it cannot be treated with this assistive device model, because the patient has symptoms of difficulty urinating, which may have more serious consequences. consult a doctor (valid) If not then proceed to the next structured question (valid)
- 4) Does the patient experience weight loss without knowing the cause?
If yes, then it cannot be treated with this assistive model, because there are symptoms of losing weight without knowing the cause. consult a doctor (valid)
If not then proceed to the next structured question (valid)
- 5) Does the patient have back pain that does not subside after you lie down?
If yes, then it cannot be treated with this assistive model, because the patient experiences back pain symptoms that do not subside after the patient lies down. consult a doctor (valid)
If not then proceed to the next structured question (valid)
- 6) Does the patient experience chest pain?
If yes, then it cannot be treated with this assistive model, because the patient experiences chest pain. consult a doctor (valid)
If not then proceed to the next structured question (valid)
- 7) Does the patient experience pain in one or both legs, especially if the pain radiates down the knee?
If yes, then it cannot be treated with this assistive model, because the patient has symptoms of pain in one or both legs, especially if the pain radiates below the knee. consult a doctor (valid)
If not then proceed to the next structured question (valid)
- 8) Does the patient experience pain that gets worse at night?
If yes, then it cannot be treated with this assistive model, because the patient has pain symptoms that get worse at night. consult a doctor (valid)
If not then proceed to the next structured question (valid)
- 9) Does the patient experience inability to hold urine and bowel movements?
If yes, then it cannot be treated with this assistive device model, because in the sand there are symptoms of not being able to hold urination and defecation. consult a doctor (valid)
If not then proceed to the next structured question (valid)
- 10) Does the patient experience numbness in the genital area, buttocks, or back of the body?
If yes, then it cannot be treated with this assistive model, because the patient has several symptoms of numbness in the genital area, buttocks, or back of the body. consult a doctor (valid)
If not then proceed to the next structured question (valid)
- 11) Does the patient have swelling and redness on the back?
If yes, then it cannot be treated with this assistive model, because the patient has symptoms of swelling and redness on the back. consult a doctor (valid)
If not then proceed to the next structured question (valid)

12) Does the patient have posture problems?

If yes, then the question will arise which posture disorder is the patient suffering from?

If you select the kyphosis image, a summary of the diagnosis information appears showing kyphosis, lordosis, and scoliosis posture disorders resulting in LBP, one of the causes is a kyphosis patient's posture disorder and can be cured with physiotherapy particular patient kyphosis(valid)

If you select an image lordosis appears the summary information for diagnosis showed impaired posture kyphosis, lordosis and scoliosis resulting LBP, one possible cause is due to interference with the posture of the patient's body lordosis and could do healing with physiotherapy particular patient lordosis(valid)

If you select the scoliosis image, a summary of the diagnosis information appears showing that scoliosis posture disorders result in LBP, one of the causes is due to a scoliosis patient's posture disorder and can be cured with special physiotherapy for scoliosis sufferers (valid) If not, a summary information appears diagnosticshowing mild LBP (valid)

The application was evaluated through Focus Group Discussion (FGD). FGD is a systematic effort in collecting data and information [13], modeling for performance measurement of computing power and system performance factors. The performance factor is measured by the user depending on the system and the complexity of the interface. The model is divided into three parts, namely Functionality, Flexibility, and Productivity [14]. FGD is done by gathering several users who have the ability to diagnose muscle strength and therapeutic solutions in cases of low back pain

myogenic. Then the user is given an explanation about the system created and also given the opportunity to use the system. Then users are asked to tell their experiences using the system and give an assessment of the system they have used. The assessed components of the system assessment are functionality, flexibility, and productivity. The functionality component consists of reliability, consistency, quality and material modeling. Flexibility components consist of display, language, creativity, convenience, grouping of actions. While the productivity component consists of information, material suitability, level of truth, completeness, and effectiveness. In addition to User testing which consists of 14 sub-indicators, there is an additional assessment referring to the Usability theory according to ISO 9126 consisting of 4 sub-indicators (Understandability, Learnability, Operability, Attractiveness). There were ten FGD respondents consisting of physiotherapists who acted as users. Physiotherapists have been invited to try the application when the discussion forum has not started, in that way it is hoped that users can provide responses to the expert system application that is being developed. Qualitative data in the questionnaire is converted into quantitative data by assigning a value to each answer. The value given is the value for positive statements with the rules STS (strongly disagree) = 1, TS (disagree) = 2, N (neutral) = 3, S (agree) = 4, and SS (strongly agree) = 5.

3. Result

The participants of the FGD are physiotherapists as users. The FGD produced the assessment of the performance of the application. Table 2 presents the results of FGD assessment.

Table 2. Results of FGD assessment

No	Indicator	Sub indicator	SD	D	N	A	SA	Total
1	Application flexibility	Appearance			2	9		42
2		Language			1	10		43
3		Creativity			3	4	4	45
4		Ease of use			2	6	3	45
5		Action grouping			2	7	2	44
6	Application functionality	Reliability			2	6	3	45
7		Consistency			2	7	2	44
8		Material model			3	6	2	43
9		Quality			2	5	4	46
10	Application productivity	Suitability of material			3	7	1	42
11		Information delivery			2	6	3	45
12		Truthfulness			3	6	2	43
13		Information completeness			3	7	1	42
14		Effectiveness			1	7	3	46
Usability compliance to ISO standard								
1	ISO compliance usability	Understand-ability			1	10		43
2		Learnability			1	10		43
3		Operability			1	8	2	45
4		Attractiveness			1	7	3	46

The total average user of acceptance of the system is calculated using the formula (1).

$$p = \frac{\sum \text{weight} \times \text{value of respondent}}{5 \times \sum \text{respondent}}$$

$$\dot{p} = \frac{\sum P}{\sum \text{Indicator}} \quad (1)$$

where:

P	= value of each indicator
\dot{P}	= Average revenue
\sum	= Total Value
$5 \sum \text{respondent}$	= 55
$\sum \text{Indicator}$	= Total 18 indicators

Our results shows that

$$\dot{p} = \frac{14.40}{18} = 0.80$$

which suggest that the average acceptance is 80%.

The hypothesis given in this research is "The performance of the expert system is acceptable to the user" with an acceptance value of 80%. Because the average total value of user acceptance is greater than the total value of acceptance, from the calculated results of 0.80, it can be concluded that the application can be accepted by the user (physiotherapist). According to 10 physiotherapists and 1 doctor the performance of the application is good.

Indicators of Improvement.

Summary of the results of the discussion through the FGD of 10 Physiotherapists and 1 Doctor, can be divided into two points about the application and about how the application will be applied to patients.

In term of application, some physiotherapists respond to slower movements, but there are other physiotherapists who respond to slow movements according to the patient's condition, so examples of movements in this model of assistive devices do not have to be slowed down (very slow). Especially For Muscle Strength 4 which carries the load, it is better to slow down a little. The application should be added with sound to explain each movement, such as what kind of sitting position and what kind of movement, but there are other physiotherapists who argue that medical language in cases of decreased muscle strength is difficult to translate into layman's language so that with examples of movements appropriate and clear is sufficient.

In order to help patients performing self-therapy, Physiotherapists request that the results of the compilation of the .swf model of this tool to be copied in the form of a CD (compact disk) which will be tested on their patients. The webbase version should be provided so that patients can use this model of assistive devices via online.

4. Discussion

The result of research show that the application using forward chaining can help the user to detect low back

pain. This is in accordance with the research conducted by Husin on an expert system for detecting diseases based on complaints of urination using forward chaining. He revealed that the application is very helpful for user because it can be useful for diagnosing types of diseases based on complaints of urination, how to treat it, explanations the disease, and is also equipped with the cause of the disease experienced by patient based on the various his symptoms experiences. Forward Chaining can be used as an inference engine in cases of myogenic low back pain, because the reasoning used in this research must start from the facts section first, to reach the hypothesis. By using an expert system in application, it can substitute the ability of experts in health problems based on complaints of urination, furthermore patients can use them to solve the problems they experience independently without having to visit or present an expert directly so that he can conclude a diagnosis, Causes, treatment and prevention his disease. The important one is that this system is built based on the knowledge of experts who are mastering of a disease so that it can be trusted for certainty of diagnosis, causes, as well as treatment and prevention that must be done [15]. A similar research was also conducted by Ariyawan [16]. In her report she declares that with the application of an expert system the user can analyze the disease, and can find out the treatment quickly and precisely without inviting experts, can gain the time and costs. With this system, user may consult with an expert of the disease.

We can conclude that expert systems help humans to solve problems quickly without an expert to diagnose, provide therapy and advice on treatment and prevention of a disease, besides this expert system is not expensive, save money and time

5. Conclusion

Rule-Based Reasoning can be used as an expert system knowledge Base, and Forward Chaining as an inference engine, for application of myogenic low back pain therapy. The expert system application for myogenic low back pain can be accepted by the user. This can be seen from the acceptance value which results that "the ten physiotherapists and one doctor consider the application performance to be good" with an acceptance value of 0.80 or 80%. According to the physiotherapist, this assistive device model is likely to increase the intensity of therapy because it can be carried out by the patient's family independently.

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