Diagnosis of Some Diseases in Medicine via computerized Experts System

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ABSTRACT

Nowadays medical application especially diagnosis of some heart diseases has been rapidly increased because its importance and effectiveness to detect diseases and classify patients. In this research, we present the design of an expert system that aims to provide the patient with background for suitable diagnosis and treatment (Especially Angina Pectoris and Myocardial infarction). The proposed methodology is composed of four stages. The first stage is receiving the symptoms from the patient. The second stage is requesting from the patient to make some analysis and investigation to help the system to make a correct decision in the diagnosis. The third stage is doing diagnosis of patient according to information from patient (symptoms, analysis and investigation). The four stage is determining the name of appropriate medication or what should be done until the patient recovers (step therapy), so this system is able to give appropriate diagnosis and treatment for two heart diseases namely; angina pectoris and infarction. There are several programs used for diagnosis and system analysis, such as CLIPS and PROLOG. A medical expert system in this search made by Visual Prolog 7.3 is proposed.

GENERAL TERMS

Experts System, Diagnosis, medical, coronary artery diseases

KEYWORDS

Experts System, Diagnosis, medical, CLIPS, PROLOG, coronary artery diseases

1. INTRODUCTION

Increasing computer-based methods improve the quality of medical services. Artificial Intelligence (AI) is the area of computer science focusing on creating machines that can engage on behaviors that humans consider intelligent [1]. One of the most important areas of Artificial Intelligence (AI) is an Expert system. The proposed system for dealing with the problem of heart diseases diagnosis and treatment is an expert system. Expert System (ES) is widely used in many areas and it has many applications. Most important fields area of expert system is the medicine and it use in detection, diagnosing symptoms and treatment diseases. The user can interact with a computer to solve a certain problem by expert system. This is because the expert system can store heuristic knowledge. The development of expert system is implemented in visual prolog v7.3 programming environment [2]. These programming tools facilitate human knowledge or expertise for medical therapy. The reason for Visual prolog program is the flexibility the expandability and low lost. This helps medical expert (doctor) diagnosis of a patient rightly. The Coronary Artery Diseases consist of a lot of Diseases that have common symptoms. Some of them have similar symptom that make very difficult even for Cardiologist (specialist) to put a right diagnosis. This Expert System
can do that. Diagnosis of Ischemic heart diseases is initially based on the symptoms that
the person is suffering and the result of investigation. Many cases of heart diseases can
lead to death. However, if detected early enough, the heart can be saved [3]. In this
paper, we will introduce a system for diagnosis human heart diseases and treatment
using visual prolog V 7.3.

We present in section 2 is previous work showing Expert system and medical data, section 3
shows the function of the proposed system. Section 4 shows Building diagnosis expert system
using visual prolog V 7.3.

2. STATE-OF-ART

An expert system (ES) known as knowledge based system, is a computer program that uses
knowledge and inference procedures to solve problems that are ordinarily solved through human
expertise. The main components of an ES are: a) knowledge base, b) inference engine, c) user-
interface.

There are many applications of expert systems such as diagnosis, design, planning, financial
decision making etc. Most applications of expert systems in medicine involve predicting,
diagnosing and treating a particular disease [4]. Now expert systems has many other roles in
clinical care such as disease prevention, therapy, rehabilitation of the patient after therapy etc. n
medicine, expert systems are used to train the medical students on various medical tasks. In
certain situations, where either the case is quite complex or there is no medical experts readily
available for patients medical expert systems are useful. From the very beginning the main
obstacle of using expert systems in medicine has been the accuracy of such systems [5]. The
development of an expert system requires medical data of specialized doctor. This data is
collected in two phases. Firstly, the creation of personal interview between doctor and patient
record the medical background of heart disease. Secondly, medical data is turned into rules (IF-
THEN). Rules for diagnosis contain in IF part the symptoms and in THEN part the disease. Rules
for treatment contain in IF part the disease and in THEN part the treatment. The inference engine
(forward reasoning) is the mechanism through which rules are selected to be fired. It is based on a
pattern matching algorithm whose main purpose is to associate the facts (input data) with
applicable rules form the rule base. Finally, the heart diseases are produced by the inference
engine [6].

Coronary heart disease (CHD) is the most common form of heart disease and the single most
important cause of premature death in certain parts of world. Disease of the coronary arteries is
almost always due to sudden death. This research presents design of an expert system for
diagnosis and treatment of coronary artery diseases namely ; angina pectoris and myocardial
infarction.

1-Angina pectoris causes chest pain which is radiated to left shoulder, medial aspect of left arm ,
forearm and medial 2 fingers ,its duration not <2 minutes and not >20 minutes precipitated by
effort and relived by rest and sublingual nitrates ,associated with nausea , tachycardia vomiting ,
sweating and Hypertension. ESG at rest is normal, post do exercise ECG: stress test is depressed
ST segment [7].

2-Myocardial infarction (MI) remains a leading cause of morbidity and mortality worldwide.
Myocardial infarction occurs when myocardial ischemia, a diminished blood supply to the heart,
exceeds a critical threshold and overwhelms myocardial cellular repair mechanisms designed to
maintain normal operating function and homeostasis. ECG: Abnormal Q-waves "due to necrosis ",
Raised ST segment or Depression and Inversion of T-wave [7].
Symptom diseases are classified into strong, moderate and mild as shown in table 1. This table shows clustering of symptom's facts to avoid repetition. We can use AND/OR to connect a premise clauses in compound rule as shown in fig 1.

If there symptom(s) Dyspnea (mild)  
AND shock (mild)  
AND weak in heart sound (mild)  
AND chest pain (mild-moderate)  
AND Gallop in heart sound (mild)  
AND paradoxical splitting of 2nd heart sound (mild)  
AND BI.P(Hypertension)  
AND pulse (Tachycardia)  
AND Duration of pain (not <20 min and not >20 min)  
OR fever (mild)  
OR nausea (mild)  
OR palpitation (mild)  
THEN the Disease is Angina pectoris

Fig1. An example for production rule

But this information is not enough for Ischemic heart diseases diagnosis we need to do investigation also reach to correct diagnosis and then a correct treatment to ischemic heart diseases.

Table 1: Heart diseases symptom's clustering template

<table>
<thead>
<tr>
<th>Symptoms Disease</th>
<th>Angina pectoris</th>
<th>Infarction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mild</td>
<td>Strong(sever)</td>
</tr>
<tr>
<td>-Dyspnea</td>
<td>Mild</td>
<td>Strong</td>
</tr>
<tr>
<td>-Shock</td>
<td>Mild</td>
<td>Strong</td>
</tr>
<tr>
<td>-Weak in heart sound</td>
<td>Mild</td>
<td>Strong</td>
</tr>
<tr>
<td>-Gallop in heart sound</td>
<td>Mild</td>
<td>Strong</td>
</tr>
<tr>
<td>-Paradoxical splitting of 2nd heart sound</td>
<td>...............</td>
<td>Mild</td>
</tr>
<tr>
<td>-Paradoxical splitting of 4th heart sound</td>
<td>...............</td>
<td>Mild</td>
</tr>
<tr>
<td>Pericardial rub-</td>
<td>Hypertension</td>
<td>Hypertension</td>
</tr>
<tr>
<td>-BI-P</td>
<td>Tachycardia</td>
<td>Tachycardia</td>
</tr>
<tr>
<td>-Pulse</td>
<td>Mild-moderate</td>
<td>Strong</td>
</tr>
<tr>
<td></td>
<td>Mild</td>
<td>Strong</td>
</tr>
<tr>
<td>Duration of pain</td>
<td>Chest pain</td>
<td>Palpitation</td>
</tr>
<tr>
<td>-----------------</td>
<td>------------</td>
<td>-------------</td>
</tr>
<tr>
<td>&gt;20 min</td>
<td>Mild</td>
<td>Mild</td>
</tr>
<tr>
<td>&lt;20 min</td>
<td>Mild</td>
<td>Mild</td>
</tr>
</tbody>
</table>

**Table 2. Ischemic heart diseases to Investigation (ECG at rest)**

<table>
<thead>
<tr>
<th>ECG</th>
<th>Normal</th>
<th>Ischemia</th>
<th>Angina</th>
<th>Infarction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>T</td>
<td>F</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>Change in T-wave and ST segment</td>
<td>F</td>
<td>T</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>Depressed ST segment</td>
<td>F</td>
<td>F</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>Deep Q-wave and elevated ST segment</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>T</td>
</tr>
</tbody>
</table>

**Table 3. Ischemic heart diseases to Investigation (ECG at stress):**

<table>
<thead>
<tr>
<th>ECG</th>
<th>Normal</th>
<th>Ischemia</th>
<th>Angina</th>
<th>Infarction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>T</td>
<td>F</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>Change in T-wave and ST segment</td>
<td>F</td>
<td>T</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>Depressed ST segment</td>
<td>F</td>
<td>F</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>Deep Q-wave and elevated ST segment</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>T</td>
</tr>
</tbody>
</table>

**Table 4. Ischemic diseases to investigation (ECHO):**

<table>
<thead>
<tr>
<th>ECHO</th>
<th>Normal</th>
<th>Ischemia</th>
<th>Angina</th>
<th>Infarction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>T</td>
<td>F</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>Abnormal motion of cardiac muscle</td>
<td>F</td>
<td>T</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>Akinsia</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>T</td>
</tr>
</tbody>
</table>
Investigation is classified into ECG (at rest), ECG (at stress), ECHO as shown in table 2.3.4. We can use AND/OR to connect a premise clauses in compound rule as shown in fig 2

| If there investigation (s) ECG(normal) AND exercise EcG(change in T-wave and ST segment) AND ECHO (Abnormal motion of cardiac muscle) OR ECG (change in T-wave and ST segment) THEN the Disease is Ischemia |

Fig2. an example for production rule

Table5. Determine type of Ischemia:

<table>
<thead>
<tr>
<th>Dinitra tab sublingual</th>
<th>Improve</th>
<th>Not improve</th>
</tr>
</thead>
<tbody>
<tr>
<td>After 1st tab</td>
<td>Angina pectoris</td>
<td>Take 2nd tab</td>
</tr>
<tr>
<td>After 2nd tab</td>
<td>Angina pectoris</td>
<td>Take 3rd tab</td>
</tr>
<tr>
<td>After 3rd tab</td>
<td>Angina pectoris</td>
<td>Infarction</td>
</tr>
</tbody>
</table>

We can use AND/OR to connect a premise clauses in compound rule as shown in fig 3

| If patient(s) improve (after 1st tab) OR Improve (after 2nd tab) OR Improve (after 3rd tab) THEN The Disease is Angina pectoris |

Fig3. An example for production rule

3. PROPOSED FRAMEWORK

3.1 Flowcharts

The proposed program is receiving the symptoms from patient for diagnosis and treatment of ischemic heart diseases by asking about: personal history, family history, symptoms, signs and then requires doing investigation to give a correct diagnosis.

First, let us present the Algorithm for ischemic heart diseases to investigation
Here is the Algorithm for ischemic heart diseases to investigation:

**Algorithm of chest pain**

- Patient has chest pain
  - Pain is Constant
    - Yes
    - No
    - Pain increased by breathing
      - Yes
      - No
      - Duration of Pain>20 min
        - Yes
        - No
  - Myocardial Infarction
  - Pulmonary Embolism
  - Pericarditis Muscular

**Algorithm of investigation**

- Patient has chest pain
  - Patient do ECG at rest
    - Normal
    - Patient do ECHO at rest
      - Normal
      - Abnormal motion of cardiac muscle
        - Patient has chest pain
          - Patients do ECG at stress
            - Deep in Q-wave and elevated ST-segment
              - Disease is Myocardial Infarction
        - Disease is Angina pectoris
          - Patients do ECG at stress
            - Depress in ST-segment
              - Disease is Angina pectoris
            - Change in T-wave and elevated ST-segment
              - Disease is Angina pectoris
  - Angina Pectoris
  - Myocardial Infarction

Fig 4: chest pain flowchart

Fig 5: investigation flowchart

Here is the Algorithm for ischemic heart diseases to ischemia:
This rules discussed the diagnosis of Ischemic heart diseases (angina pectoris and myocardial infarction) by do investigation to get actually diagnosis to patient and then treatment. We will present the rule for ischemic heart diseases to Treatment.

fig 7 shows the description of the rules for treatment of coronary artery diseases:

**IF** Medical Diagnosis (angina pectoris)

**THEN** Treatment (R/Dinitra 5, 10 mg Sublingual Tab

, Beta blocker e.g Tenormin[ATENOLOL]

25,50,100 mg Tab, Aggrex[ASPIRIN]75 mg Tab

, Isoptine [VERAPAMIL] 80 mg Tab, stop smoking

,tea,coffee,decrease weight, do some exercise."

**IF** Medical Diagnosis (myocardial infarction)

**THEN** Treatment (Morphine 10 mg Amp

streptokinase (e.g Angikinase 300000,500000 IU Vails),

Heparin Amp 5000Units s.c.8-12 hours,

teronormin[ATENOLOL] Amp, Tab, Aspirin 75 mg

,Beta blockers,Stop smoking ,tea,coffee

,do some exercise as walking.

The description of the rules generated by using PROLOG PROGRAM:
Rule 1

Treatment (R/Dinitra 5, 10 mg Sublingual Tab, Beta blocker e.g Tenormin [ATENOLOL] 25,50,100 mg Tab, Aggrex [ASPIRIN] 75 mg Tab, Isoptine [VERAPAMIL] 80 mg Tab, stop smoking, tea, coffee, decrease weight, do some exercise.

Rule 2

Treatment (R/Morphine 10 mg Amp, streptokinase (e.g Angikinase 300000, 500000 IU Vials), Heparin Amp 5000 Units s.c. 8-12 hours, teronormin [ATENO:O:] Amp, Tab, Aspirin 75 mg, Beta blockers. Stop smoking, tea, coffee, do some exercise as walking.

3.2 User Interface

Figures 7, 19 show project main screen. Figures 8, 9, 10, 11, 12 and 13, 14, 15 show the system input patient data screens for heart diagnosis. The system asks a doctor (user) about the demographic data concerns information such as patient; age, sex cardiology risk factors, clinical data symptoms and signs through different dialogues and store answer in its knowledge base. Figures 16, 17 show the system input patient investigation screens for heart diagnosis. After finishing the questions concerning the symptoms dialogue, the results appear as shown in fig 18. After determining type diseases, the treatment appear as shown in fig 20.
Fig. 8. Input data for heart diagnosis 1st screen.

Fig. 9. Input data for heart diagnosis 2nd screen.

Fig. 10. Input data for heart diagnosis 3rd screen.

Fig. 11. Input data for heart diagnosis 4th screen.

Fig. 12. Input data for heart diagnosis 5th screen.
Fig. 13. Input data for heart diagnosis 6th screen.

Fig. 14. Input data for heart diagnosis 7th screen.

Fig. 15. Input data for heart diagnosis 8th screen.

Fig. 16. Input investigation for heart diagnosis 1st screen.

Fig. 17. Input investigation for heart diagnosis 2nd screen.
4. CONCLUSION

The expert systems have an interesting application. In addition, ES has created considerable importance systems of diagnosis. Doctors and patients get help from the propose system. ES provides decision support system, Interactive training tool and expert advice. The system displays diagnosis of heart disease using intelligent system. The proposed system is essentially a production a production rule system (i.e., composed of IF-THEN) used conjunction with uncertainty reasoning. In the next research we will explain how to design Graphical user interface by using previous rules in visual prolog version 7.3 and how turning on the program by user.

This paper described a prototype model of a expert system for diagnosing and treatment heart diseases. The system uses the rule-based reasoning technique through simple querying of symptoms, signs and investigation done to the patient. The system can be used for diagnosing heart disease patient and then give treatment.
REFERENCES