Decision Support System In Heart Disease Diagnosis By Case Based Recommendation

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Abstract: Heart disease is the main leading killer as well as a major cause of disability. Its timely detection and correct diagnosis plays a vital role in human life. In a limited period of time recalling the data from Doctor's unaided memory may lead to wrong judgments. While taking decisions, Doctor analyses the physical condition and test results of the patient. In the same way our system compares the data provided to Doctor and getting a result through CBR technique. Results from the system will help the Doctor to conclude the decision and reduce human errors may occur. Our system is able to analyze scanned results of heart and being a helping hand to the doctor in all manners.

Index Terms: Case Based Reasoning, Case Based Recommendation, Image Processing, Knowledge Base, Neural Network, Retain, Retrieve, Reuse, Revise.

1 INTRODUCTION

Man strives to augment his abilities by building tools. These tools have extended his ability to sense and to manipulate the world about him. Today we stand on the threshold of new technical developments which will augment man's reasoning, the computer and the programming methods being devised for it are the new tools to effect this change. Medicine is a field in which such help is critically needed. Our increasing expectations of the highest quality health care and the rapid growth of ever more detailed medical knowledge leave the Doctor without adequate time to devote to each case and struggling to keep up with the newest developments in his field. For lack of time, most medical decisions must be based on rapid judgments of the case relying on the Doctor's unaided memory. Only in rare situations can a literature search or other extended investigation be undertaken to assure the doctor (and the patient) that the latest knowledge is brought to bear on any particular case. Continued training and recertification procedures encourage the Doctor to keep more of the relevant information constantly in mind, but fundamental limitations of human memory and recall coupled with the growth of knowledge assure that most of what is known cannot be known by most individuals. It is the opportunity for new computer tools: to help organize, store, and retrieve appropriate medical knowledge needed by the practitioner in dealing with each difficult case, and to suggest appropriate diagnostic, prognostic and therapeutic decisions and decision making techniques. Correct diagnosis of heart disease at an early stage is a demanding task due to the complex interdependence on various factors. Another major challenge faced by hospital is the provision of quality services at affordable cost. These are the motivations to develop medical diagnosis prediction system which can predict heart disease by processing the previous known cases. Working on heart disease patients databases is one kind of a real-life application.

The databases include several factors and attributes. Therefore, CBR was proposed for supporting diagnosis of heart disease in this study. CBR has been used in various problem-solving areas such as financial forecasting, credit analysis and medical diagnosis. In addition, CBR is chosen because CBR is appropriate in medicine for some important reasons: cognitive adequateness, explicit experience, duality of objective and subjective knowledge, and system integration. CBR is unlike the traditional rule-based approach in which expert knowledge must be represented in “if-then” rules, CBR manages attributes to be grouped and stored.

2 BACKGROUND

Heart disease is a class of diseases that involves the heart or blood vessels. Heart disease is the second leading cause of death in Malaysia for men and women. There are many different forms of heart disease. The most common cause of heart disease is narrowing or blockage of the coronary arteries which are the blood vessels that supply blood to the heart itself. This is called coronary artery disease and it happens slowly over time. It is the major reason people have heart attack. Other types of heart problems may happen to the valves in the heart, or the heart may not pump well and causes heart failure. There are some people who are born with heart disease. Many things increase the risk for heart disease, and mostly people want to reduce those risk factors. In this case, the factors are:

- Having diabetes which is a strong risk for heart disease.
- Substance abuse such as cocaine
- Being overweight
- Not getting enough exercise and feel depressed or having excess stress
- Smoking
- High blood pressure increases the risks of heart disease and heart failure
- Excess cholesterol in blood build up inside the walls of heart’s arteries (blood vessels).

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TABLE 1
HEART DISEASE ATTRIBUTES AND DESCRIPTION

Sl. No.	Attributes	Description	Values
1	Age	Age of patients in year	Integer
2	Gender	Gender of patients	Male/female
3	CP	Chest pain type Angina: typical angina Abnang: Atypical angina Notang:Non-angina pain Asympt: Asymptomatic	Four types
4	Trestbps	Resting blood pressure in mmHg on admission to the hospital	Integer
5	Chol	Serum Cholesterol in mg/dl	Integer
6	FBS	Fasting sugar pressure>120 mg/dl True = 1; False = 0	0, 1
7	RestEcg	Resting electrocardiographic result 0: Normal 1: having ST-T wave abnormality 2: showing probability or definite left ventricular hypertrophy	0 – 2
8	Thalach	Maximum heart rate achieved	Integer
9	Exang	Exercise included angina True = 1; False = 0	0, 1
10	OldPeak	ST depression Included by exercise relative to rest	Float
11	Slope	Slope of peak exercise ST segment 1: up sloping 2: flat 3: down sloping	1 – 3
12	CA	Number of major vessels colored by fluoroscopy (0-3)	0 - 3
13	Thal	Defect type 3: Normal 6: Fixed defect 7: reversible defect	3, 6, 7
14	Result	Heart Disease buff: Healthy sick: Sick	buff, sick
Patient ID	Patient's identification number	Integer	

People can help to reduce the risk of heart disease by taking steps to control factors mentioned, for example by controlling the blood pressure, lowering the cholesterol level, refraining from smoking and having enough exercise.

3 PROPOSED SYSTEM

3.1 Problem Statement

Heart disease is the second leading killer disease in Malaysia. It is also a major cause of disability (Health Topics, 2010). Generally, doctors and health professionals use their knowledge and experience to make decision for the diagnosis of heart disease for patients. Usually, most of the medical data collected from patients are just saved in files or kept in folders. Generally, those huge amounts of messy medical records have not meaning for users. Using CBR, a technique which solves a new problem by remembering a previous case and by reusing information and knowledge of that case, CBR turn those data into useful information that can help to make decision support system for the diagnosis of heart disease. This system can be used to assist doctor and support education for the undergraduate and postgraduate young physicians as a tool to improve the quality of care for the patients. This system can be used as a reference for those student and new doctor. Presently, doctors have difficulties in determining heart disease in a new patient who does not have existing medical record. Therefore, those data can be used to diagnose heart disease for new patients who do not have existing medical records. This system is designed to assist doctor and health professionals in determining the diagnosis of patient data. Therefore, this system could help doctors and health professionals to determine the diagnosis and analysis of the patient health status.

3.2 Objectives

Objectives of this study are:

- To develop an intelligent clinical decision support system for the diagnosis of heart disease.
- To use CBR algorithm to predict heart disease in patient.

3.3 Proposed Method

The way of doctors and health professionals diagnose heart disease depends on their experience and knowledge. That way is similar to decision support system using CBR approach. CBR algorithm has 4 phases which are retrieve, reuse, revise and retain. But our system only uses retrieve and reuse technique in whole cycle of CBR algorithm.(Revise and retain can be considered as manual phases. Revising a case need an expert in the same field who can differentiate the existing case from new and giving recommendations to the same. Both the case and recommendations will keep in the database through retain phase.)In addition, Scanned images of 2D echo cardio graphic, EEG, ECG and heart images are feed into as input and extract features like density are used to check normal or abnormality condition of the heart through image processing technique.

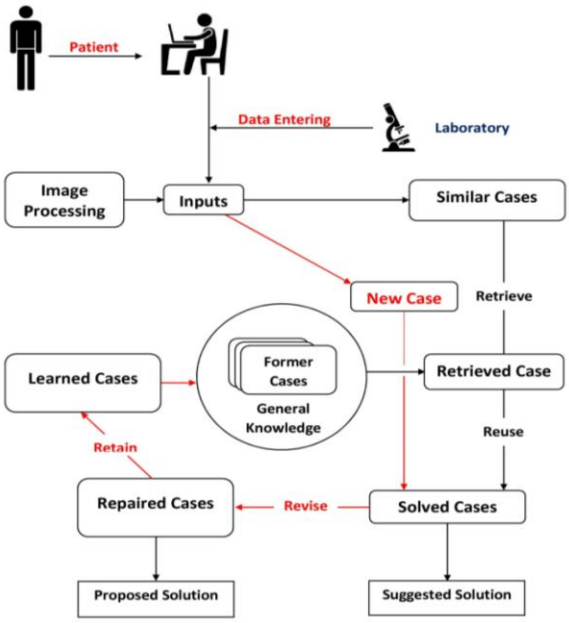

Fig. 1. *Proposed System Execution*

Doctors analyzing a patient through the outcome of critical factors (i.e., Blood pressure, Cholesterol level, Heart pulse rating, ECG, EEG, BMI etc.) and the feedback of queries during consultation. Scanned images of 2D echo cardio graphic, EEG, ECG and heart images are feed into as input and extract features like density are used to check normal or abnormality condition of the heart through image processing technique. Feedbacks from the patient will be entered manually by Doctor during consultation. These values will be

distributed to the Doctor as well as CBR algorithm simultaneously. Input to our system looks like an application form having a couple of queries related to the disease. Once the form gets completed, CBR algorithm will start. It analyses the values and recognizes both the case and solution. It is not only a recommendation system but also a patient profile reviewer. This will help the doctor when he is going to consult an existing patient, our system will brief the patient history to the doctor. Once updated, after the consultation it will give the progress in his/her health condition along with recommendation.

4 Architectural Design for Proposed System

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4.1 Data Flow Diagram (DFD)

As the name indicates, the diagram shown below explains how the data is flowing in the proposed system. Here data flow starts from the user (ie, Doctor) while consulting a patient. Doctor enters the visual and verbal examination results as data. In the same way Laboratory staff will feed the test results recommended by Doctor.

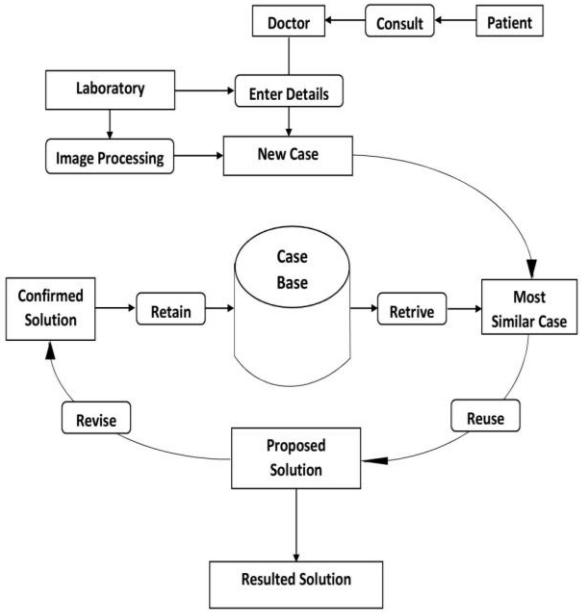

Fig. 2. *Proposed System Execution*

If the Doctor goes for advanced technologies like 2D echo cardio graphic, ECG, EEG or scanning, the required data will be extracted by image processing module and feed with data entered by Doctor and Laboratory module will form a new case. The new case will go to CBR, first of all it retrieve a most similar case from the case base and reuse that case as our proposed solution. Finally doctor reviews and accept the proposed solution as his suggestion. When our input case didn't matches with cases stored in the case base, it should be analyzed by the experts in this field to find the most suitable solution for the case. The revised solution of new case will retain in the case base for future reference. That's why revise and retain phases are done manually.

5 Implementation

The proposed system is about to be built as using MAT Lab. Consequently the system can run over a variety of operating systems including Windows and Linux which are most popular operating systems in use. When we consider the hardware requirements, we require a system with reasonable processing power and primary memory. The computer system on which we wish to implement the proposed model is expected to have a color monitor, Keyboard with 101 keys, a mouse and a modem that can help the system connect to the internet. On the software side, for the implementation of the proposed system we may need to install additional application to update the existing version of applications already installed. This Project is a helping hand to the doctors who are using. It is very user friendly as the function indicates. The project uses almost all the terms and definitions that will be familiar to the user to make it more effective. We can introduce this system to any of the medical fields (i.e., Psychiatry, Cancer Care, and General Medicine etc.) and other suitable areas to make them more reliable.

5.1 Data Extraction

It looks like a query-feedback system but beyond that acts as a guide to the users through giving recommendations from

other experts in the same field. For each query we allotted places for the feedback in the same. Once the doctor giving feedbacks from his observations, Laboratory gives some values of test preferred by doctor and results of advanced techniques like 2D echo cardio graphic, ECG, EEG or scanning will initiate the data flow. Image processing technique extracts values of features that can reflect abnormalities in the image (i.e., Density of film in X-ray film interpretation). These values will be compared with CBR cycle and will give the recommendation as final result. User need not be aware about the functions happening behind the process, it makes the system more feasible for operation.

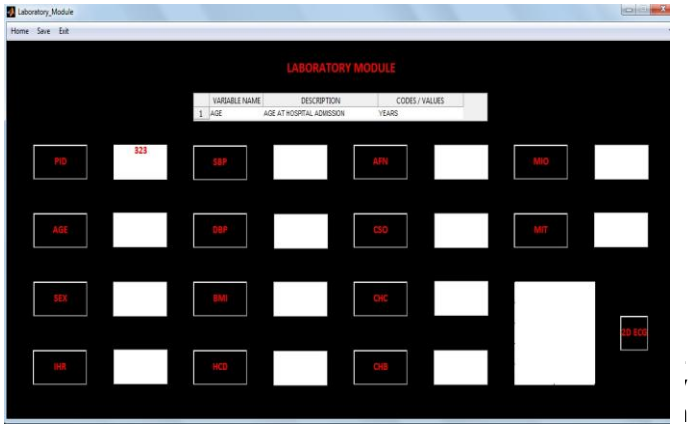

Fig. 3. *Data Extraction*

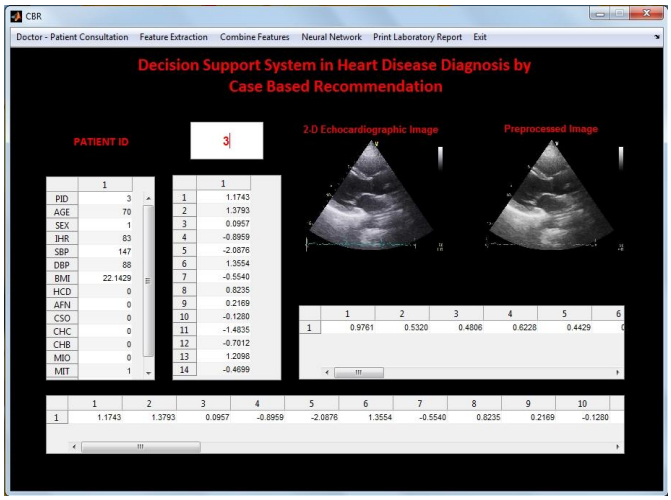

Fig. 4. *Image Extraction*

5.1.2 Gabor Algorithm

Here we extract the image details by using Gabor algorithm, this Gabor is mainly used in image processing. Frequently and orientation representations of Gabor filter are similar to human visual system. Particularly appropriate for texture representation and discrimination. Image analysis with Gabor filter is through to be similar to prescription in human visual system. After done by Gabor algorithm we get processed image with minimum Gabor scale and orientation. These extracted values will be represented in the table.

5.1.3 Neural Networks

Neural network is mainly used for the working of CBR .An Artificial Neural Network (ANN) is an information processing paradigm that is inspired by the way biological nervous systems, such as the brain, process information. The key element of this paradigm is the novel structure of the information processing system. It is composed of a large number of highly interconnected processing elements (neurons) working in unison to solve specific problems. ANNs, like people, learn by example. An ANN is configured for a specific application, such as pattern recognition or data classification, through a learning process. Learning in biological systems involves adjustments to the synaptic connections that exist between the neurons. This is true of ANNs as well. After completing this neural network process we get the output of our project that means the normality and abnormality of the heart.

6 Future Work

CBR system can provide a case library which motivates a new direction of data mining and knowledge discovery and combination with CBR. For example in post-operative pain treatment domain, there were more than 1500 reference cases in the case library, so the clustering approach in terms of data mining and knowledge discovery could be used in order to identify unusual cases (outliers) from the regular ones. Here, a novel combination of the FCM and Hierarchical clustering which was able to identify 18% of cases as rare cases. This group of unusual case together with regular one can be stored into the case library and the retrieval function of the CBR system could consider the most similar groups and present to a clinician accordingly. This could also help to reduce retrieval time in the CBR system. Currently, the stress diagnosis system is expanded to use it in a professional driving situation. The driver cases could lead to new research challenges in developing the CBR systems and meeting these challenges could positively impact on the advancement of CBR systems for health care in professional environment.

7 Conclusion

There is growing recognition that Clinical Decision Support System (CDSS), when well designed and implemented, holds great potential to improve health care quality and possibly even increase efficiency and reduce health care costs For the potential to be realized, CDSS should not be viewed as a technology or as a substitute for the Doctor, but as a complex intervention requiring careful consideration of its goals, how it is delivered, and who receives it. To gain optimal benefit, the Doctor needs to understand its benefits and limitations, and the unique challenges of designing and implementing the different types of CDS. Those responsible for implementation need to recognize that CDS requires careful integration into the clinical workflow, which will take effort and involvement on the part of users. The high frequency of failure to attend to the CDS alerts and recommendations represents a challenge for both researchers and vendors. Researchers need to address the cognitive, informatics, structural, and workflow issues that lead to less than optimal CDSS design or implementation and, therefore, limited use and effectiveness. Fortunately the opportunities in the current environment hold promise for increased use of CDSS. In addition, the new generation of clinicians has trained in academic medical centres and other environments with advanced IT systems and is likely to be comfortable with technology, as will many of their patients. All of these factors are likely to lead to a more receptive environment for use of health IT. The outcome of this project will be a detailed recommendation to the doctor while giving

medicine prescriptions and routine healthy practices. Our system is supposed to help Doctors do more with less by identify at-risk patients, eliminating inappropriate procedures and to help Doctors adhere to practice guidelines. It is unreasonable to expect them to remember hundreds of pages of ever-changing appropriate use criteria, which is where Decision Support System can offer an instant resource. In addition, the system records the history of each patient and provides review to doctor before next consultation. Once the system updated with current status it will compare the health condition of patient and assess the changes.

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