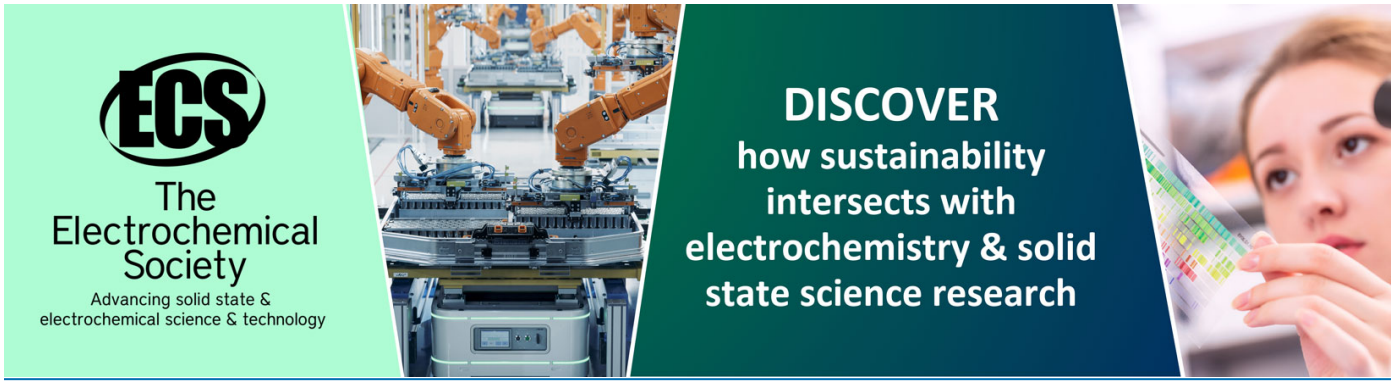
A knowledge based system for diagnosing heart diseases



A knowledge based system for diagnosing heart diseases

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Abstract. The purpose of this study was to design a knowledge based expert system for diagnosing heart diseases by using forward chaining as one of inference technique and analyse the software functionality through black box testing. The heart organ chosen because many mortality rates are caused by sudden heart attacks. The research method consists of seven stages: preliminary studies, data collection, knowledge acquisition, knowledge representation, knowledge implementation, system evaluation, and the last, drawing conclusions. The software application recognizes the type of heart disease after consultation by answering a few questions about the symptoms of disease that displayed by the system, and can infer the type of heart diseases suffered by the patient. Based on the results of black box testing, the expert system application has been running with good functionality. The knowledge based expert system is designed to provide solutions or initial actions that can be performed by patient in relation to heart disease he suffered (early detection).

1. Introduction

A knowledge-based system is a form of artificial intelligence (AI) that has the knowledge of human experts to support decision-making. Examples of knowledge-based systems include expert systems, which are so called because of their reliance on human expertise [1]. The typical architecture of a knowledge-based system includes two main parts, a knowledge base and an inference engine. Medical diagnosis is example of the knowledge base of information in a given field. The inference engine deduces insights from information housed in the knowledge base. Knowledge-based systems also include an interface through which users query the system and interact with it.

The imbalance between the number of patient and the number of doctor became one of the medical problems occurring recently. Limitations of an expert (doctor) sometimes become an obstacle for people who will consult to get the best treatment solution associated with the disease suffered. People can obtain knowledge about health from books or internet sites, however, it is not easy to learn because it takes a long time. In this case, expert system is presented as an alternative in solving the medical problem.

Expert system is a piece of software programmed using Artificial Intelligence (AI) techniques. Such systems use databases of expert knowledge to offer advice or make decisions in such areas as medical diagnosis and trading on the stock exchange [2].

The diagnosis method plays an important role in disease diagnosis and accuracy of its treatment. A diagnosis expert system can help a great deal in identifying those diseases and describing methods of treatment to be carried out; taking into account the user capability in order to deal and interact with expert system easily and clearly [3].

There are different areas in medical where an expert system has been designed and implemented to proffers solution to health status stability in human. Among these diverse areas includes an expert system for Breast Cancer [4], Blood Disorder [5], Neurodegenerative [6] and several other human diseases.

Related research in terms of medical diagnosis was also carried out by several researchers, including Metwally et. al using an artificial neural network (ANN) model for diagnose patients with hepatitis [7]. The model used feed forward backpropagation algorithm for training and test data evaluation shows that the ANN model is able to correctly predict the diagnosis of more than 93% of prospective patients. In previous study, Munaiseche et al. in their research for expert system to diagnosis eye diseases that extend their work into 16 types of eye diseases with 41 symptoms of the disease, arranged in 16 rules and the system evaluation result through usability testing showed the expert system for diagnosis eye diseases had very good rate of usability, which includes learnability, efficiency, memorability, errors, and satisfaction so that the system can be received in the operasional environment [8]. Also, Tuan et.al proposed a novel framework called Dental Diagnosis System (DDS) for dental diagnosis based on the hybrid approach of segmentation, classification and decision making [9]. It utilized the best dental image segmentation method based on semi-supervised fuzzy clustering for the segmentation task.

This study aimed to design a knowledge based system that called expert system application for diagnosing heart diseases by using forward chaining technique and analyse the software functionality through black box testing. The scope of the study is extended to 10 types of heart diseases with 33 symptoms of the disease, arranged in 10 rules that were called the Rule-Based System.

The main contribution is the experts system for diagnosing heart disease has become an expert knowledge sharing tool to be used by other medical personnel who are not specialists in diagnosis of heart diseases, specially for hospitals that do not have an cardiologist. The research's novelty is the expert system based on web and user friendly so that can be accessed by everyone wherever and whenever easily and using PHP programming language and MySQL as the Relational Database Management System (RDBMS). The advantage of this research, as a guide for the patient in taking initial action if they know the possibility of suffering heart disease (early detection).

2. Methods

Research procedures consist of seven phases: problem identification, data collection, knowledge acquisition, knowledge representation, knowledge implementation, system evaluation, and drawing conclusions. The methodology in this study is shown in figure 1.

2.1. Problem identification

Identifying the problem and opportunity where the organization can obtain benefits from expert system, and establishing the expert system general goals.

2.2. Data collection

Collecting data from domain expert: type of heart diseases, symptoms, disease information and solutions provided. The data required in this study were obtained from literature study and consultation/interview with experts, in this case cardiologist.

2.3. Knowledge acquisition

Extracting domain knowledge from domain experts and determining the system's requirements. Based on the collected data, the researcher conducted following steps:

- Giving code the types and symptoms of each heart diseases. There was 10 types of heart diseases with 33 symptoms of the diseases.

- Creating a knowledge table. From existing data of diseases and symptoms, the information can be shortened into a decision table, the relationship between the disease and its symptoms.

2.4. Knowledge representation

Representing key concepts from domain and inter relationships between these concepts using formal representation methods. In this phase, expert knowledge is encoded as rules and is referred to as rule-based system. The knowledge representation that researcher used is the Production Rules. There are 10 rules base.

2.5. Knowledge implementation

Coding the formalized knowledge in to a working prototype The activity performed at this stage was the programming or coding. This stage was the translation of the design into the form of computer programming language. This research employed PHP programming language.

2.6. System evaluation

The evaluation of this expert system uses blackbox testing (software functionality test).

2.7. Conclusion

A conclusion will be drawn from the results of these evaluations based on the results of testing (black box testing) of the expert system.

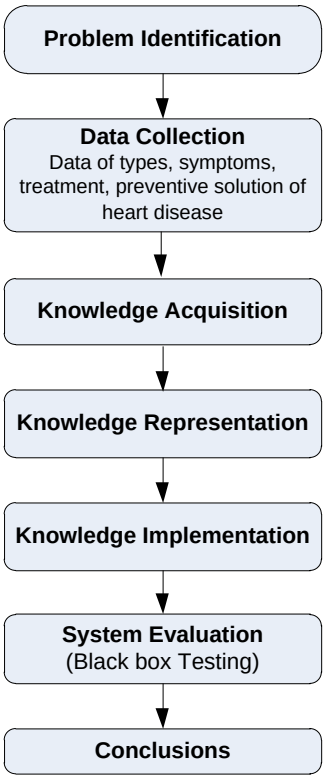

Figure 1. Research prosedur.

3. Results and discussion

This research results in a web-based expert system that can recognize the type of heart disease in humans based on the symptoms experienced by patients.

This system performs analysis based on the dialogue between the system with the user/patient [10]. The web-based expert system of heart disease diagnosis is designed by using PHP programming language and MySQL for database processing.

Figure 2. Main menu interface.

The user interface is an interface used by general users. On the main menu in figure 2, the application consists of five menus, namely: *Beranda* (Home), *Jenis Penyakit* (List of diseases), *Konsultasi* (Consultation), *Login Pakar* (Expert Login), *Informasi* (Information). Figure 3 shows consultation application form and figure 4 shows diagnosis result.

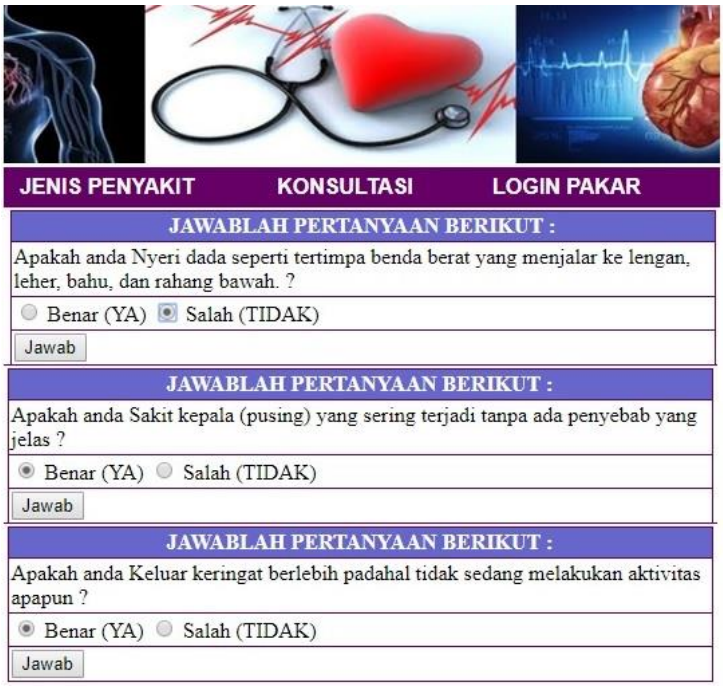

Figure 3. Consultation application form.

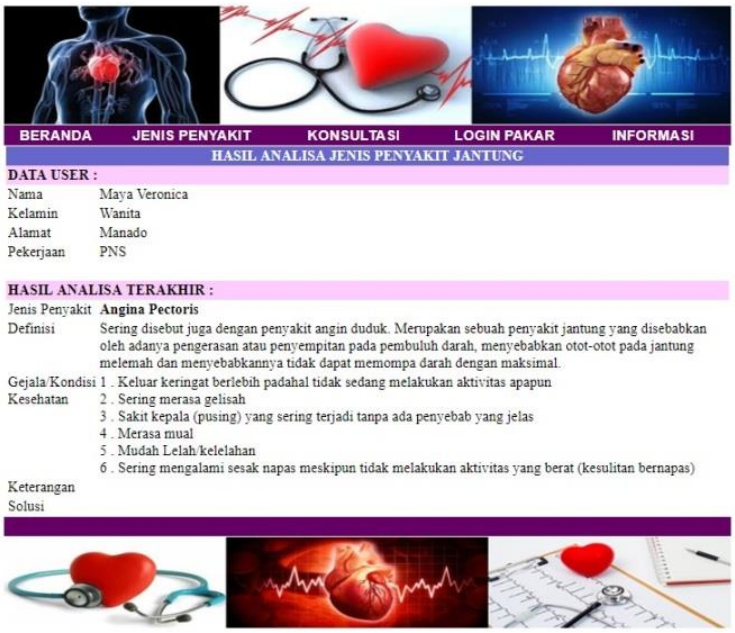

Figure 4. Diagnosis result.

Evaluation for this application using blackbox testing. Blackbox testing focuses on functional requirements of software. The results of black box testing, application of knowledge based expert system has been running with good functionality.

4. Conclusion

The results obtained showed that the expert system was able to successfully diagnose heart diseases corresponding to the selected symptoms entered as query. Expert system application to diagnose heart disease can built by using forward chaining method as an inference technique and rule-based approach as a knowledge representation. Expert system application built to recognize the type of heart disease after consultation by answering a few questions about the symptoms of disease that displayed by the system, and can infer the type of heart diseases suffered by the patient. The system can only diagnose one patient in consultation and can only recognize and diagnose the type of heart disease that presented in the truth table/knowledge table. Based on the results of black box testing, the expert system application has been running with good functionality.

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