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Implementation of Improved Forward Chaining Method using Certainty Factor on Web-Based Application in Resulting First Disease Prediction

Muhammad Barja Sanjaya[1], Ady Purna Kurniawan[2], Rinez Asprinola[3]

[1,3] Department of Applied Information System, School of Applied Science, Telkom University, Bandung, West Java, Indonesia,

[2] Department of Multimedia System, School of Applied Science, Telkom University, Bandung, West Java, Indonesia

[1]mbarja@tass.telkomuniversity.ac.id, [2]ady.purna.kurniawan@tass.telkomuniversity.ac.id, [3]asprinolarinez@gmail.com

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Abstract

Expert system is one of the disciplines in the era of information technology that is increasingly being discussed day by day. Forward Chaining (FC) is one of the expert system methods that can be applied and juxtaposed with medical disciplines. FC is used to formulate an outline in determining a type of general and mild disease suffered by a patient. FC forms rules that are adjusted to the description of the explanation of a doctor or a medical expert. The rules that are formed are a series of answers or responses to questions raised by the doctor to his patient. However, reviewing the results of other previous related studies, it was found that the FC method was very inadequate to be applied in the current era. Therefore, this research proposes an improvement on the implementation of FC in the form of pairing and combining Certainty Factor on some or all indicators that are adjusted to the survey results. Certainty Factor is needed to strengthen the results of the final conclusions obtained from the FC method. The combination of FC method and Certainty Factor is implemented in web-based application to produce the prediction the types of diseases experienced by students during their academic studies. The examples of diseases types that are commonly experienced such as dizziness, typhus, diarrhea, colds, vomiting, magh, cough, flu, fever, throat or even blood pressure.

Keywords; *expert system, forward chaining, certainty factor, application, prediction..*

I. INTRODUCTION

An expert system is a software whose capabilities are similiar to an expert, where the expert system tries to implement an expert's ability to do overcoming a problem and produce a solution, according to the knowledge he has [1]. Expert systems combine knowledge and data tracking to overcome problems that are normally human expertise necessary. The purpose of the expert system is actually to do substituting human knowledge in the form of systems instead of to replace the role of humans, but, so that it can be used by many people [2]. The indicators that affect to involve in expert system are knowledge, facts and reasoning techniques in solving which usually can only be solved by an expert in his field [2]. Expert system also seeks to adopt human knowledge in real life into computers, so that computers can solve problems as usual by experts.

Development of expert systems is actually not to replace the role of experts, but to implement expert knowledge in the form of applications so that it can give lots of advantages to many people and without a large cost [4]. Expert systems have a number of characteristics, namely limited to specific fields, the ability to provide reasoning for incomplete or uncertain data, the ability to express a series of reasons given in a way that can be understood, has certain rules, has a separate knowledge base and inference engine and the result is a suggestion or advice. A good expert system is designed to do processing and producing solution such as an expert solves a particular problem.

For experts, this expert system will also help their activities as an experienced assistant [5]. Essentially an expert system will combine inference rules with certain knowledge bases. The combination of these two things is stored in a computer, which is then used in the decision making process for solving certain problems..

II. LITERATURE REVIEW

The references relating to this study include:

a. Forward Chaining

Conducting inference requires the process of testing the rules in a particular order to find those that are in accordance with the initial conditions or current conditions, which have been input in the database. The inference engine looks for rules in a knowledge base whose premise is in accordance with these facts, then from these rules a conclusion is reached. Tracing is the process of matching facts, statements or running conditions stated in the premise or part of the conditions in the rules. The forward chaining mehod is a tracking process that starts by displaying a convincing collection of data or facts to a final conclusion [5]. The forward chaining method starts with premises or information input (**if**) first then goes to the conclusion (**then**). Input information in the form of data, evidence, findings, or observations. Whereas conclusions can be in the form of objectives, hypotheses, explanations or diagnoses (Figure 1). The forward chaining method starts the process of searching with data so it is also called data-driven [6].

Next in Figure 1 forward chaining method is described including an example of several vertices (Node) and edges (Edge).

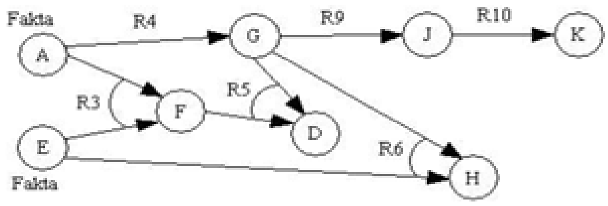

Figure 1. Forward Chaining method [6]

b. Certainty Factor

The certainty factor method is used when dealing with a problem for which the answer is uncertain. This uncertainty can be a probability. This method was introduced by Shortlife Buchanan in the 1970s. He used this method when conducting a diagnosis and treatment of meningitis and blood infections [10]. The development team of this method notes that, doctors often analyze existing information with phrases such as “maybe”, “almost certain”. This method is similar to Fuzzy logic, because uncertainty is represented by the degree of trust whereas the difference is in Fuzzy logic when calculating for rules whose premise is more than one, Fuzzy logic does not have a confidence value for the rule so the calculation only sees the smallest value for the AND operator or the greatest value for OR operators of each premise which in the rule is different from the certainty factor is that each rule has its own belief value not only the premises that have a confidence value. Certainty factor shows the measure of certainty of a fact or rule [10].

$$CF[h,e] = MB[h,e] - MD[h,e] \quad \ldots(1)$$

CF[*h*,*e*] represents for certainty factor, MB[*h*,*e*] signifies for *measure of belief*, measure of confidence or level of confidence in the hypothesis (*h*), if given *evidence* (*e*) is in range between 0 and 1, whereas MD[h,e] states *measure of disbelief*, a measure of distrust or the level of confidence in the

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hypothesis (*h*), if given *evidence* (*e*) is in range between 0 and 1. The several certainty factor combinations of certain premises are namely:

1. CF with one premise, it is notated as CF[h,e]. It multiplies CF[e] to CF[rule]
2. CF with more than one premise. First, it can be notated as CF[A ∧ B] and it calculates the minimum result of multiplication CF[a] and CF[b] to CF[rule]. Whereas it is notated as CF[A ∨ B], it calculates the maximum result of multiplication CF[a] and CF[b] to CF[rule].
3. Certainty factor with similiar conclusion. The method is to combine CF1 and CF2, and it can be formulated as

Cfcombined [CF1, CF2] = CF1 + CF2 * (1 – CF1) …(1)

The advantage of this method is suitable for use in expert system that measure something certain on uncertain such as diagnosing a disease and calculation of this method only applies to one count, and can only process two data so that its accuracy is maintained [6]..

III. METODOLOGY AND DISCUSSION

This section presents a design related to website-based applications that apply a combination of FC and Certainty Factor methods..

a. Design of Flowchart

Figure 2 shows flowchart diagram system that was built.

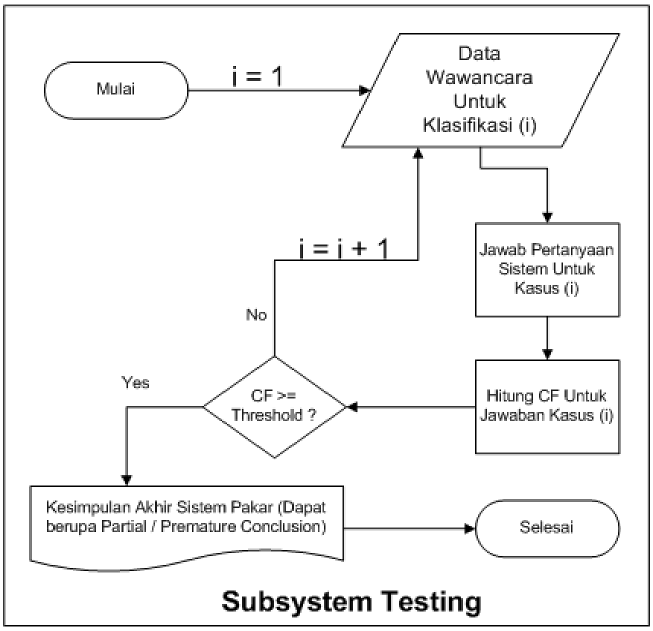

Figure 2. System Flowchart

b. Design of Database

Figure 3 shows a diagram of database relation scheme created.

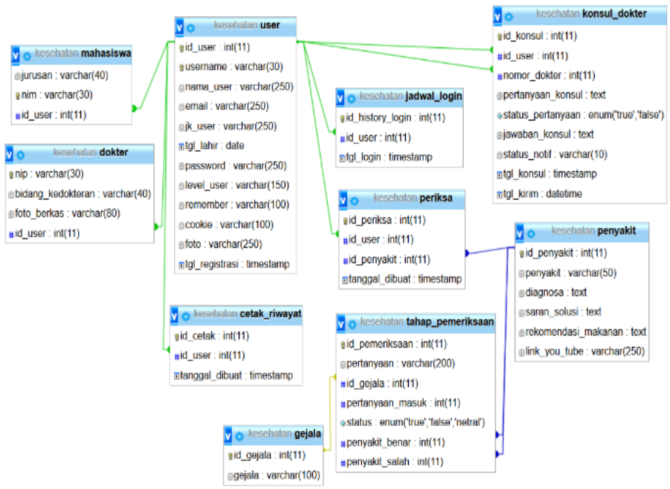

Figure 3. Database relation schema diagram

c. Design of Usecase

Figure 4 shows a usecase diagram tailored to the application.

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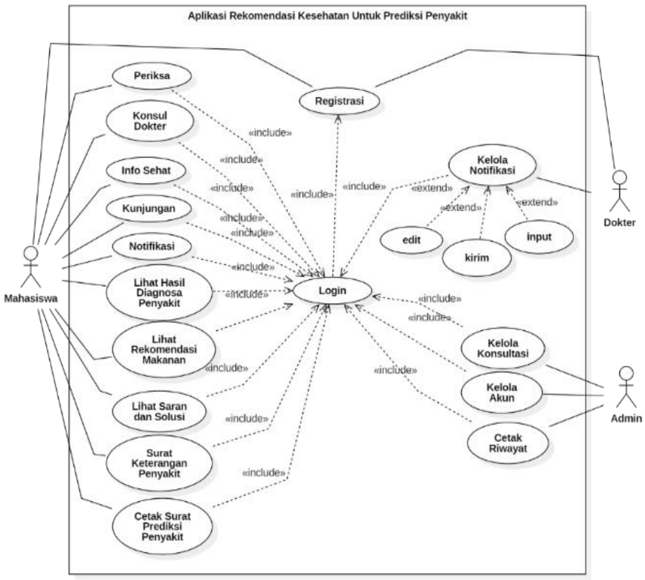

Figure 4. Usecase diagram

d. Design of User Interface

The appearance of the user interface created is as follows.

a. User Interface Design for displaying registration features.

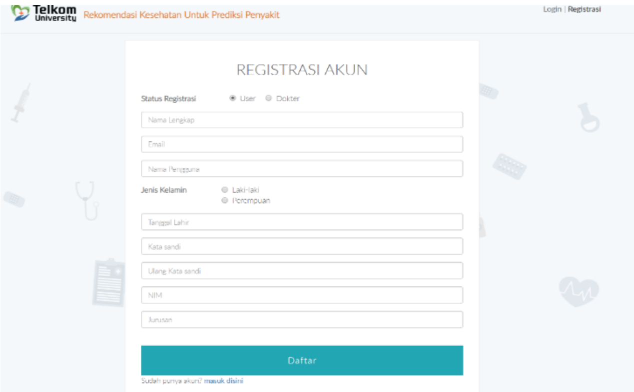

Figure 5. Displaying registration for user account

b. User Interface Design for displaying login feature

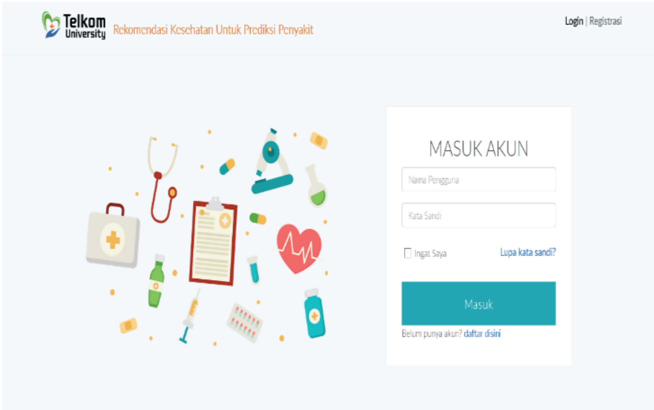

Figure 6. Displaying login feature

c. User Interface Design for displaying the check feature.

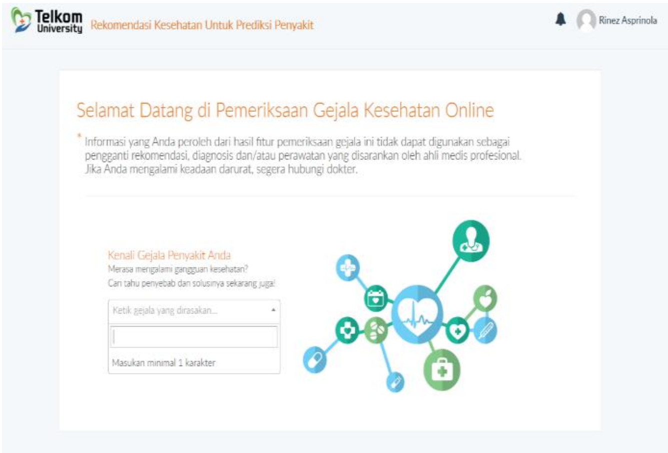

Figure 7. Displaying the check feature

d. User Interface Design for displaying the check feature (for input to FC).

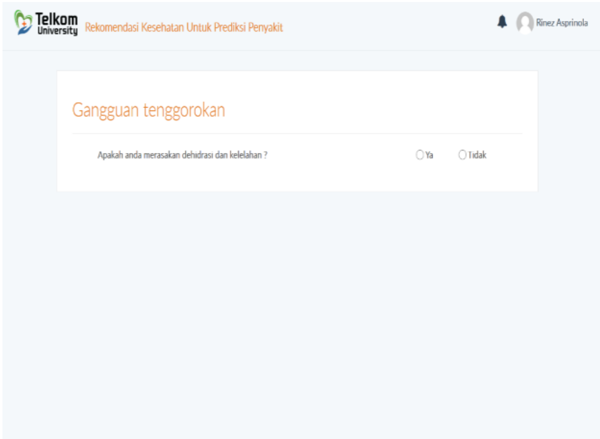

Figure 8. Displaying the check feature (answer question)

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e. User Interface Design for displaying the diagnose result and disease prediction.

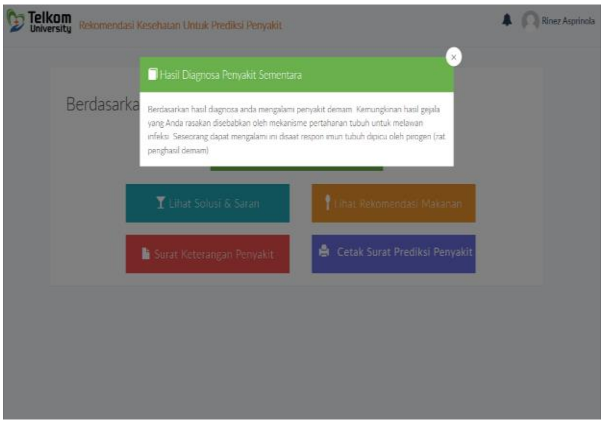

Figure 9. Displaying the diagnose result and disease prediction

IV. TESTING SYSTEM

As for the system testing carriedd out, it aims to::

i. Calculate the level of accuracy before and after improvisation.

ii. Calculate the percentage of improvement obtained after improvisation.

iii. Calculate the level of performance and computational efficiency after improvisation in terms of computational time and memory requirements during computing.

iv. Present the results on the application using Black Box Testing method.

V. CONCLUSION

Following are the conclusion points obtained from the Black Box Testing system test results, including:

a. Applying the Forward Chaining expert system that has been improvised in the form of merging Certainty Factor to the system.

b. The results of improvement that has been conducted is implemented in application in feature of health consulting service.

c. The application has provided input error handling features on each form in each feature that has been made.

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