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JURNAL INFOKUM, Volume 10, No.1, Desember 2021 ISSN : 2302-9706

APPLICATION OF THE EXPERT SYSTEM OF CERTAINTY FACTOR METHODS IN DIAGNOSING THYROID DISEASE

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Abstract

Article Info
Received : 29 November 2021
Revised : 11 December 2021
Accepted : 20 December 2021

Thyroid gland disease or what is called hyperthyroidism is a disease that is often found in the community. The body's need for thyroid hormone is needed to control body growth and process food metabolism into energy. An overactive thyroid gland produces thyroid hormone which causes high levels of thyroid hormone in the blood. This condition is known as hyperthyroidism. In the medical world, to be able to diagnose hyperthyroidism is difficult, because the symptoms of hyperthyroidism vary greatly, depending on the rise and fall of thyroid hormones. From the above problems, a technology utilization is needed to reduce each problem and implement it into an expert system. An expert system is a branch of artificial intelligence that uses special knowledge/knowledge to solve problems at the human expert/expert level. Expert systems have been developed in various sciences, one of which is in the field of medicine to diagnose diseases. The expert system used to determine the diagnosis of the disease will help confirm the diagnosis and provide advice and therapy in the treatment of the disease. The test results "Expert System Diagnosing Hyperthyroid Disease Using the Certainty Factor Method" show that this expert system can diagnose hyperthyroidism according to the answers given by the user with an accuracy value of 100%.

Keywords: Hipertiroid, Certainty Factor

1. Introduction

Diagnosis of thyroid disease is difficult, because the symptoms of thyroid disease can vary depending on the rise and fall of thyroid hormones. Thyroid hormones increase the use of oxygen by the body's cells. When the thyroid produces excess hormones, the body's cells will work harder and the body's metabolism will be faster, this condition is called hyperthyroidism. When the thyroid does not produce enough hormones, the body's cells work more slowly, a condition known as hypothyroidism. In addition to thyroid examination and investigation, the proper interpretation of clinical data is an important complement in thyroid disease diagnosis[1]. A person will find it difficult to know that he has thyroid disease because the symptoms of thyroid disease are often similar to other diseases such as tonsillitis and other diseases so that there are often wrong estimates. In fact, if it is not detected and treated early, thyroid disorders can reduce productivity and quality of life, so people need to be aware of thyroid disorders [2].

An expert system is a branch of artificial intelligence that uses special knowledge/knowledge to solve problems at the human expert/expert level. Expert systems have been developed in various sciences, one of which is in the field of medicine to diagnose diseases[3]. The expert system used to determine the diagnosis of the disease will help confirm the diagnosis and provide advice and therapy in the treatment of the disease [4].

Based on the research problems above, the authors are interested in conducting research with the title **"Application of the Expert System of Certainty Factor Methods in Diagnosing Thyroid Disease"**.

2. Research Background

In research applying the certainty factor method can simplify and provide a calculation of the completion of how certain the user or patient suffers from dengue fever. Symptoms of dengue fever have been successfully represented in the form of a rule so that it can be understood by the computer[5] [6].

The results of research on certainty factors in making diagnoses where the results show conformity with the symptoms experienced by cats. The manufacture of an expert system begins with the collection of symptom data, treatment and prevention methods along with the cf value for symptoms[7].

The results of this system research can analyze the types of skin diseases in humans based on the symptoms suffered by the patient. This system will display a number of questions regarding the symptoms of skin diseases in humans, where the patient can carry out the diagnostic process only by answering questions from the system regarding the symptoms of the disease experienced by the patient[8] [9]. This system is able to store representations of expert knowledge based on the value of trust (Certainty Factor).

3. Research Method

The certainty factor expresses belief in an event (fact or hypothesis) based on evidence or expert judgment. Certainty factor uses a value to assume the degree of confidence of an expert in a data.

The description of the system flow (flowchart) from the application of the certainty factor method in the design of the application to detect hyperthyroidism can be seen in Figure 1. as follows:

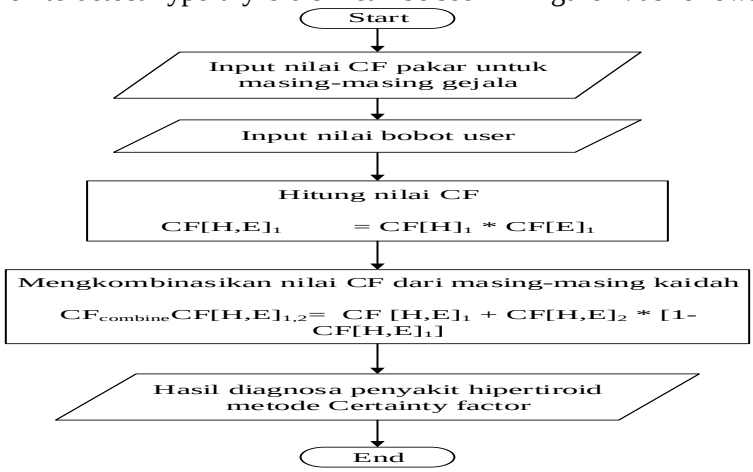

Figure 1. Flowchart of Certainty Factor Method

The steps for the calculation of the certainty factor method are as follows:

$$CF[H,E] = MB[H,E]-MD[H,E] \quad \text{.....(1)}$$

Description :

CF(H,E) = the certainty factor of the hypothesis that is influenced by the known evidence e with certainty.

MB(H,E) = measure of belief against hypothesis H, if given evidence E (between 0 and 1).

MD(H,E) = measure of disbelief against evidence H, if given evidence H, if given evidence E (between 0 and 1).

Certainty factor for the single premise rule is as follows:

"CF[H,E"]_1 " = CF" ["H"]"-CF[E]"

Certainty factor for rules with similar conclusions (similarly concluded rules):
CFcombineCF[H,E]1,2= CF [H,E]1 + CF[H,E]2 * [1-CF[H,E]1]
CFcombineCF[H,E]old,3= CF[H,E]old + CF[H,E]3 * [1-CF[H,E]old]

The knowledge base in this expert system will be used to determine the search process or determine the conclusions obtained from the results of the analysis. The results obtained after the user interacts with the expert system are by answering questions posed by the expert system. The knowledge base used in this expert system consists of the name of the disease and the symptoms suffered by the patient.

4. Results and Analysis

The following is an example of the application of the certainty factor method in diagnosing hyperthyroidism. As for the logic of the certainty factor method in the system diagnosis session, the diagnosis user is given a choice of answers, each of which has the following weights:

Table 1. User Value Table

No.	Description	Value *User*
1	Not	0
2	Do not know	0.2
3	A little sure	0.4
4	Pretty Sure	0.6
5	Certain	0.8
6	Very sure	1

A value of 0 indicates that the diagnostic user informs that kidney disease does not have symptoms like what the system asks for. The more consultation users believe that these symptoms are in hyperthyroidism, the higher the percentage of confidence results obtained. The process of calculating the percentage of confidence begins with solving a rule that has multiple premises, into rules that have a single premise. Then each new rule is calculated its certainty factor, so that the certainty factor value is obtained for each rule, then the certainty factor value is combined. For example, the process of assigning weights to each premise (traits) to obtain a percentage of confidence for hyperthyroidism.

The production rules or rules related to hyperthyroidism are as follows:
IF Thyroid gland is enlarged
AND Libido decreases
AND Excessive sweating
AND Fast heart rate
AND Excessive thirst
AND Losing weight
AND Fatigue
AND Irregular menstrual flow
AND Goiter
THEN Hyperthyroid
The first step, the expert determines the CF value for each symptom as follows:
CF_{pakar1} = MB[H,E] - MD[H,E]
= 1.0 - 0.1

= 0.9

CF_{pakar2} = MB[H,E] - MD[H,E]
= 0.9 - 0.1
= 0.8

CF_{pakar3} = MB[H,E] - MD[H,E]
= 0.8 - 0.2
= 0.6

CF_{pakar4}= MB[H,E] - MD[H,E]
= 0.8 - 0.2
= 0.6

CF_{pakar5}= MB[H,E] - MD[H,E]
= 0.9 - 0.1
= 0.8

CF_{pakar6}= MB[H,E] - MD[H,E]
= 0.8 - 0.2
= 0.6

CF_{pakar7} = MB[H,E] - MD[H,E]
= 0.8 - 0.2
= 0.6

CF_{pakar8} = MB[H,E] - MD[H,E]
= 0.8 - 0.1
= 0.7

CF_{pakar9} = MB[H,E] - MD[H,E]
= 0.9 - 0.2
= 0.7

CFexpert1(thyroid gland is enlarged) = 0.9
CFexpert2(Libido decreased) = 0.8
CFexpert3(Excessive sweating) = 0.6
CFexpert4(Fast heart rate) = 0.6
CFexpert5(Excessive thirst) = 0.8
CFexpert6(Losing weight) = 0.6
CFexpert7(Fatigue) = 0.6
CFexpert8(Irregular or scanty menstrual flow) = 0.7
CFexpert9(Mumps) = 0.7

Then proceed with determining the user's weight value. Suppose the user chooses an answer as follows:

Thyroid gland is enlarged = sure = 0.8
Decreased libido = Slightly Confident = 0.4
Excessive sweating = Pretty Sure = 0.6
Fast heart rate = Slightly sure = 0.4
Excessive thirst = Slightly Confident = 0.4
Losing weight = Pretty sure = 0.6
Fatigue = Pretty Sure = 0.6
Irregular or scanty menstrual flow = Don't know = 0.2
Goiter = Pretty Sure = 0.6

The second step, the rules are then calculated the CF value by multiplying the expert CF by CFuser to become:

$CF[H,E]_1 = CF[H]_1 * CF[E]_1$
$= 0.9 * 0.8$
$= 0.72$

$CF[H,E]_2 = CF[H]_2 * CF[E]_2$
$= 0.8 * 0.4$
$= 0.32$

$CF[H,E]_3 = CF[H]_3 * CF[E]_3$
$= 0.6 * 0.6$
$= 0.36$

$CF[H,E]_4 = CF[H]_4 * CF[E]_4$
$= 0.6 * 0.4$
$= 0.24$

$CF[H,E]_5 = CF[H]_5 * CF[E]_5$
$= 0.8 * 0.4$
$= 0.32$

$CF[H,E]_6 = CF[H]_6 * CF[E]_6$
$= 0.6 * 0.6$
$= 0.36$

$CF[H,E]_7 = CF[H]_7 * CF[E]_7$
$= 0.6 * 0.6$
$= 0.36$

$CF[H,E]_8 = CF[H]_8 * CF[E]_8$
$= 0.7 * 0.2$
$= 0.14$

$CF[H,E]_9 = CF[H]_9 * CF[E]_9$
$= 0.7 * 0.6$
$= 0.42$

The last step is to combine the CF values of each rule. Here is the combination of CF[H,E]1 with CF[H,E]2 :

$CF_{combine}\, CF[H,E]_{1,2} = CF[H,E]_1 + CF[H,E]_2 * (1\text{-}CF[H,E]_1)$
$= 0.72 + 0.32 * (1 - 0.72)$
$= 0.72 + 0.09$
$= 0.81_{old1}$

$CF_{combine}\, CF[H,E]_{old,2} = CF[H,E]_{old1} + CF[H,E]_3 * (1\text{-}CF[H,E]_{old1})$
$= 0.81 + 0.36 * (1 - 0.81)$
$= 0.81 + 0.07$
$= 0.88_{old2}$

$CF_{combine}\, CF[H,E]_{old,2,4} = CF[H,E]_{old2} + CF[H,E]_4 * (1\text{-}CF[H,E]_{old2})$
$= 0.88 + 0.24 * (1 - 0.88)$
$= 0.88 + 0.03$
$= 0.91_{old2}$

$CF_{combine}\, CF[H,E]_{old,3,5} = CF[H,E]_{old3} + CF[H,E]_5 * (1\text{-}CF[H,E]_{old3})$
$= 0.91 + 0.32 * (1 - 0.91)$
$= 0.91 + 0.03$

$= 0.94_{old3}$

$CF_{combine}\ CF[H,E]_{old,4,6} = CF[H,E]_{old4} + CF[H,E]_{6} * (1-CF[H,E]_{old4})$
$= 0.94 + 0.36 * (1 - 0.94)$
$= 0.94 + 0.02$
$= 0.96_{old4}$

$CF_{combine}\ CF[H,E]_{old,5,7} = CF[H,E]_{old5} + CF[H,E]_{7} * (1-CF[H,E]_{old5})$
$= 0.96 + 0.36 * (1 - 0.96)$
$= 0.96 + 0.014$
$= 0.98_{old5}$

$CF_{combine}\ CF[H,E]_{old,6,8} = CF[H,E]_{old6} + CF[H,E]_{8} * (1-CF[H,E]_{old8})$
$= 0.98 + 0.14 * (1 - 0.98)$
$= 0.98 + 0.002$
$= 0.98_{old7}$

$CF_{combine}\ CF[H,E]_{old,7,9} = CF[H,E]_{old7} + CF[H,E]_{9} * (1-CF[H,E]_{old7})$
$= 0.98 + 0.42 * (1 - 0.98)$
$= 0.98 + 0.008$
$= 0.99_{old7}$

$CF[H,E]_{old7} * 100\ \%$ $= 0.99 * 100\%$
$= 99\ \%$

Thus it can be said that the certainty factor calculation in hyperthyroidism has a 99% confidence level percentage.

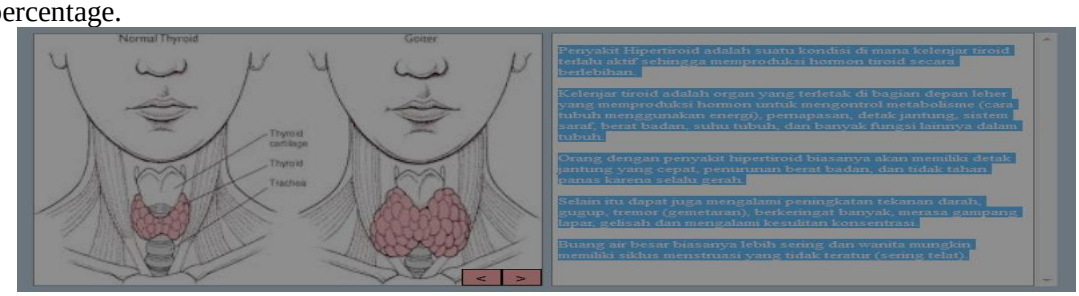

Figure 1. Display of Disease Form

4. Conclusions

Based on the designed or created system entitled Expert System for Diagnosing Hypertroid Disease Using the Certainty Factor Method, the conclusions of this system are:

1. Application Design for Detecting Hyperthyroidism Using Certainty Factor Method. Where this system is made to make it easier for the public to get information about hyperthyroid disease, it is hoped that the system that has been built can also increase public knowledge in detecting hyperthyroid disease.
2. The system designed can be used for the community because it is very easy to use, no need to have special skills about computers. So that people can use this system to generate reports on hyperthyroidism, with this system it can also save people's costs, because there is no need to go to a doctor just for a consultation.
3. The test results "Expert System Diagnosing Hyperthyroid Disease Using the Certainty Factor Method" show that this expert system can diagnose hyperthyroidism in accordance with the answers given by the user with an accuracy value of 100%.

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