

Application Of Certainty Factor Method To Diagnose Gastroesophageal Reflux Disease (Gerd)

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ABSTRACT

An expert system is a computer system that analyzes knowledge, reasoning techniques in problem solving and also facts by following the abilities of an expert. In the expert system there are several methods to help solve the problem, one of which is the certainty factor method or certainty factor which will later be used to solve the problem of gastric acid disease. Because using this method can increase the confidence of an expert. This study aims to design an expert system that will be useful for the community because it can diagnose acid reflux disease or GERD. The design of an expert system is intended to facilitate performance when replacing experts by a project that cannot afford to pay more.

Keywords:

Expert System, GERD, Certainty Factor

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1. INTRODUCTION

An expert system is software that uses knowledge and inference methods to solve quite complex problems, and only an expert can solve these problems[1]–[3]. In the health sector, many expert systems have been developed to diagnose diseases, such as stomach acid disease or Gastroesophageal Reflux Disease (GERD)[4]–[8]. GERD can occur because the valve or sphincter located in the lower esophagus weakens. This weakening of the valve causes stomach acid to rise up into the esophagus.

The cause of GERD is the decreased function of the sphincter valve in the lower esophagus, as a result of the weakening of this valve is the food that is in the stomach up into the esophagus. If this is repeated, the lining of the esophagus will become irritated and inflamed and will weaken its function if left untreated. Another cause is due to disturbances in the anatomical structure, which for example occurs due to injury. Stress can also be one of the psychological causes that can cause the central nervous system of the brain associated with the stomach to experience a hormonal change in the body so that can stimulate the cells in the stomach to produce excess acid[6]. Common symptoms that arise in patients with GERD are sour and bitter mouth in the mouth and chest accompanied by a burning sensation in the pit of the heart. In addition, breathing problems, shortness of breath, nausea, vomiting, difficulty swallowing, sleep disturbances, tooth decay and bad breath are also symptoms that mark GERD[9]–[11].

In the expert system there are several methods to help solve the problem, one of which is the certainty factor method or certainty factor which will later be used to solve the problem of gastric acid disease. Because using this method can increase the confidence of an expert. Certainty factor is something that accommodates the uncertainty of thought from an expert who was first proposed in 1975 by Shortliffe and Bunchanan. Certainty factor is used to assume the degree of certainty of an expert on a data[12]. Certainty factor is used to measure certainty and uncertainty when diagnosing a disease. Calculations using this method can process up to two data in one calculation so that the accuracy of the data can be trusted[13]–[16].

The research question in this study is how to apply the Certainty Factor method to diagnose GERD? and how to design an expert system application for GERD? The purpose of this study was to find out how to apply the Certainty Factor method to diagnose GERD and to design an expert system application for the diagnosis of GERD.



2. RESEARCH METHODOLOGY

The research method used in this study is a qualitative research method. The techniques used for data collection include literature study, interviews, and observation[17], [18]. The data analysis technique used to analyze the data that has been collected is descriptive analysis technique. The data or information obtained in this study came from primary data and secondary data. For primary data, data collection was carried out by field observations and interviews. Data and information obtained through library research are data obtained from literature studies, scientific papers on expert systems and comparative studies.

The expert system method used in this study is the certainty factor method which is used as a measure of certainty to get precise and accurate results. The concept of Certainty factor itself is in the form of belief and uncertainty which is usually written in the following formula[19]:

$$CF [HE] = MB [H,E] - MD [H,E]$$

The following is a description of several combinations of Certainty Factor in various conditions [20]:

- a. $CF_{combine} CF[H,E]_{1,2} = CF[H,E]_1 + CF[H,E]_2 * [1 - CF[H,E]_1]$
- b. $CF_{combine} CF[H,E]_{old,3} = CF[H,E]_{old} + CF[H,E]_3 * (1 - CF[H,E]_{old})$

The results of the percentage of confidence in the diagnosis of gastric acid disease using Certainty Factor:

$$\text{Confidence percentage result} = CF_{combination} * 100\%$$

There are several stages carried out before conducting research:

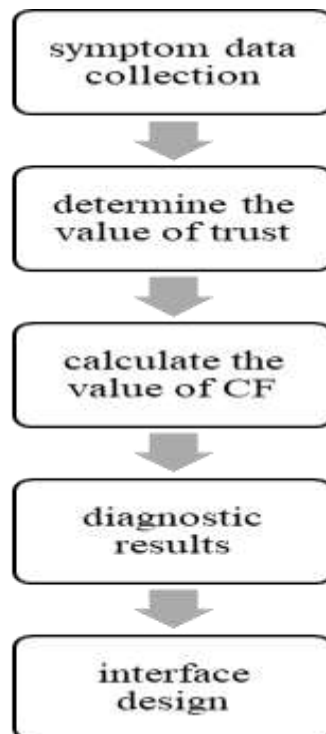


Figure 1. Research Framework

1. Symptom data collection is a process where the user determines what symptoms he feels. At this stage, an interview with a specialist in internal medicine is conducted to find out what symptoms may occur in patients with GERD.
2. After getting a list of symptoms, the next step is to determine the confidence value, which is to determine the CF value of each symptomatic belief.

3. The next step is to calculate the CF value, which is a process where each CF value is calculated with the symptoms specified by the user.
4. The next step is to get a diagnostic result that determines whether the user suffers from acid reflux disease or not.

After the results are obtained, the diagnostic results are displayed in a system design.

3. RESEARCH RESULT

3.1. Symptom Data Collection

Based on the results of interviews that have been conducted, it is known that the symptoms that may occur in patients with GERD are flatulence, nausea and vomiting, sour mouth, difficulty swallowing, chest pain, sore throat and sleep disturbance. Each of these symptoms has a different level of certainty.

3.2. Determine the Value of Trust

The confidence level category is divided into 4 groups, namely very uncertain, quite certain, certain and very certain. The confidence value of each category can be seen in the table below.

Table 1. Trust Value

| Confidence Level | CF Value |
|------------------|----------|
| Very Uncertain | 0.2 |
| Quite Certain | 0.5 |
| Certain | 0.8 |
| Very Certain | 1 |

Table 2. CF value GERD symptoms

| Symptom Code | Symptom Name | CF Value |
|--------------|-----------------------|----------|
| G1 | flatulence | 0.2 |
| G2 | nausea and vomiting | 0.4 |
| G3 | sour mouth | 0.1 |
| G4 | difficulty swallowing | 0.2 |
| G5 | chest pain | 0.5 |
| G6 | sore throat | 0.3 |
| G7 | sleep disturbance | 0.1 |

3.3. Calculate the Value of CF

Sample case:

For example, the user selects symptoms from the following that have a CF value:

| | |
|--|-------|
| CF_{expert} (flatulence) | = 0.2 |
| CF_{expert} (nausea and vomiting) | = 0.4 |
| CF_{expert} (sour mouth) | = 0.1 |
| CF_{expert} (difficulty swallowing) | = 0.2 |
| CF_{expert} (chest pain) | = 0.5 |
| CF_{expert} (sore throat) | = 0.3 |
| CF_{expert} (sleep disturbance) | = 0.1 |

Then determine the Certainty Factor value by multiplying CF_{user} and CF_{expert} :

$$\begin{aligned} CF[H,E]_1 &= CF[H]_1 * CF[E]_2 \\ &= 0.8 * 0.2 \\ &= 0.16 \end{aligned}$$

$$\begin{aligned} CF[H,E]_2 &= CF[H]_2 * CF[E]_2 \\ &= 1 * 0.4 \\ &= 0.4 \end{aligned}$$

$$\begin{aligned} CF[H,E]_3 &= CF[H]_3 * CF[E]_3 \\ &= 1*0.1 \\ &= 0.1 \end{aligned}$$

$$\begin{aligned} CF[H,E]_4 &= CF[H]_4 * CF[E]_4 \\ &= 0.5*0.2 \\ &= 0.1 \end{aligned}$$

$$\begin{aligned} CF[H,E]_5 &= CF[H]_5 * CF[E]_5 \\ &= 1*0.5 \\ &= 0.5 \end{aligned}$$

$$\begin{aligned} CF[H,E]_6 &= CF[H]_6 * CF[E]_6 \\ &= 0.8*0.3 \\ &= 0.24 \end{aligned}$$

$$\begin{aligned} CF[H,E]_7 &= CF[H]_7 * CF[E]_7 \\ &= 0.5*0.1 \\ &= 0.05 \end{aligned}$$

3.4. Diagnostic Result

Next, determine the value of the Certainty Factor combination:

$$\begin{aligned} CF_{combine} CF[H,E]_{1,2} &= CF[H,E]_1 + CF[H,E]_2 * (1-CF[H,E]_1) \\ &= 0.16 + 0.4 * (1-0.16) = 0.49_{old} \end{aligned}$$

$$\begin{aligned} CF_{combine} CF[H,E]_{old,3} &= CF[H,E]_{old} + CF[H,E]_3 * (1-CF[H,E]_{old}) \\ &= 0.49 + 0.1 * (1-0.49) = 0.54_{old2} \end{aligned}$$

$$\begin{aligned} CF_{combine} CF[H,E]_{old2,4} &= CF[H,E]_{old2} + CF[H,E]_4 * (1-CF[H,E]_{old2}) \\ &= 0.54 + 0.1 * (1-0.54) \\ &= 0.58_{old3} \end{aligned}$$

$$\begin{aligned} CF_{combine} CF[H,E]_{old3,5} &= CF[H,E]_{old3} + CF[H,E]_5 * (1-CF[H,E]_{old3}) \\ &= 0.58 + 0.5 * (1-0.58) \\ &= 0.79_{old4} \end{aligned}$$

$$\begin{aligned} CF_{combine} CF[H,E]_{old4,6} &= CF[H,E]_{old4} + CF[H,E]_6 * (1-CF[H,E]_{old4}) \\ &= 0.79 + 0.24 * (1-0.79) \\ &= 0.84_{old5} \end{aligned}$$

$$\begin{aligned} CF_{combine} CF[H,E]_{old5,7} &= CF[H,E]_{old5} + CF[H,E]_7 * (1-CF[H,E]_{old5}) \\ &= 0.84 + 0.05 * (1-0.84) \\ &= 0.92_{old6} \end{aligned}$$

$$\begin{aligned} CF[H,E]_{old6} * 100 &= 0.92 * 100\% \\ &= 92\% \end{aligned}$$

From the calculation above, it can be seen that the certainty value of the patient affected by GERd is 92% and this is included in the very certain category.

3.5. Interface Design

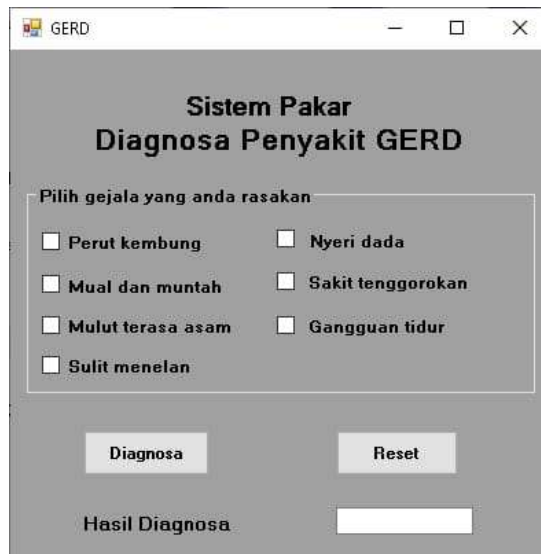


Figure 2. System Main Page

The picture above is the start page of an expert system for diagnosing GERD. This page will show the symptoms that may be experienced by GERD sufferers. To determine whether the user suffers from GERD, the user must choose the answer according to his experience. Select any symptoms the user has experienced.



Figure 3. Symptoms Checklist

Users can tick all the symptoms they experience. The diagnostic button is used to display the diagnostic results and the reset button is used to cancel all checklists.

Figure 4. Diagnostic Result

After the user presses the diagnostic button, the percentage of the diagnostic results will appear in the diagnostic results column. That way the user can find out how likely it is that he suffers from GERD. These results can help users to take the next step.

4. CONCLUSION

After analyzing and looking for the results and discussion of the previous chapters, the author can conclude that the expert system that has been created is able to make it easier for people to diagnose the gastric disease they are experiencing. By using the certainty factor method, it will be easier to calculate and complete the certainty of the user in suffering from gastric disease. By using this expert system application, the user can find out the gastric disease he is suffering from. Researchers suggest that in the next study some symptoms of GERD can be added so that sufferers can choose more of the symptoms they experience and improve the appearance that has been made by creatively designing expert systems.

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