Repeater : Publikasi Teknik Informatika dan Jaringan
Volume. 3 Nomor. 2 Tahun 2025
e-ISSN : 3046-7276, p-ISSN : 3046-7284, Hal 01-07
DOI: https://doi.org/10.62951/repeater.v3i2.387
Available online at: https://journal.aptii.or.id/index.php/Repeater

Expert System For Diagnosing Brain Tumors Using the Certainty Factor (CF) Method

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Abstract. *The development of computer technology helps many aspects of life. One aspect of life that takes advantage of technological developments is the health sector, in order to solve problems including brain tumors. Brain Tumor Disease is the growth of abnormal cells in or around the brain in an unnatural and uncontrolled manner. Patients with brain tumors continue to increase every year, because the initial symptoms are often underestimated. Therefore created a software that can help diagnose brain tumors using the certainty factor method*
Keywords*: Expert System, Artificial Intelligence, Brain Tumor, Certainty Factor*

1. INTRODUCTION

Health is the most important thing in human life. Because if healthy, then humans can carry out all activities to achieve their life goals. To maintain this health, we must regulate a healthy and regular lifestyle so that we are not easily attacked by disease. Because if we ignore a healthy and regular lifestyle, then we will easily susceptible to dangerous diseases or viruses. Many people are also aware of the symptoms of a disease but simply ignore it for various reasons such as fear of facing the reality of the disease they are suffering from.

But with that fear can lead to a more severe condition because of the delay in handling by experts. For example, one of the dangerous diseases but often ignored is a brain tumor, because the symptoms are almost the same as other diseases, for example headaches, nausea and vomiting, memory disorders, seizures, tingling, and many more. A brain tumor is a condition characterized by the growth of abnormal cells in or around the brain. These abnormal cells grow abnormally and uncontrollably. Factors that can increase the risk of brain tumors include radiation, age, heredity, and genetic disorders.

2. LITERATURE REVIEW

Artificial intelligence

Artificial intelligence or AI (Artificial Intelligence) is a simulation of human intelligence that is modeled in a machine and programmed to think like a human. It can also be said that AI is a computer system that can do jobs that generally require human power or human intelligence to complete the job. AI also requires data to be used as knowledge, and needs experience so that its intelligence can be even better, AI can also learn by itself based on the

Received: Januari 05, 2024; Revised: Janauri 20, 2024; Accepted: Februari 09, 2025; Online Available: Februuari 15, 2025

experience it has. AI is currently widely applied in various fields of life, one of which is in the medical field, with the existence of an AI system for example, it can diagnose a disease so that it is easier to find out a disease.

Expert system

Expert system is a system that tries to adopt human knowledge to computers, so that computers can solve problems as experts usually do, and a good expert system is designed to be able to solve a particular problem by imitating the work of experts (Kusumadewi, 2003:109). An expert system is a computer system that can imitate the abilities of an expert or specialist in their field. Expert systems are applied to support problem-solving activities such as diagnosis, prediction and many more.

Certainty Factor

The Certainty Factor (CF) method is chosen when facing a problem, often found answers that do not have full certainty, for example an expert (for example a doctor) often analyzes the existing information with expressions such as "possible", "most likely", "almost certain", "certain". To accommodate this, the Certainty Factor (CF) is used to describe the level of expert confidence in the problem being faced (Nofriansyah, Ramadhan, 2016) Certainty Factor (CF) shows the measure of certainty of facts or regulations. The general formula for the certainty factor method is as follows:

CF[h,e] = MB[h,e] – MD[h,e]

Information :

CF[h,e] = certainty factor

MB[h,e] = measure of confidence/level of belief in hypothesis h, given/influenced by evidence e (between 0 and 1)

MD[h,e] = measure of disbelief/level of uncertainty towards hypothesis h, given/influenced by evidence e (between 0 and 1)

Brain Tumor

Tumor is a term used to indicate the presence of abnormal tissue growth in the body. Tumors are divided into two, namely benign tumors and malignant tumors or commonly known as cancer. If the tumor is still early and has not disturbed the surrounding tissue, the tumor is usually in the form of a lump and is not painful, so many sufferers are not aware of the tumor disease from the beginning. And brain tumors themselves are diseases that arise due to the

growth of abnormal tissue in the brain. Symptoms of brain tumors can vary depending on the type, size, growth rate, and location of the tumor itself.

There are several symptoms that can diagnose a brain tumor, namely:

1. Headaches gradually become more frequent and more severe.
2. Nausea and vomiting without cause
3. Memory disorders
4. Seizures
5. Tingling and numbness in the arms and legs
6. Vision problems such as blurred vision
7. Problems related to the sense of hearing
8. Balance disorders, difficulty moving

3. RESEARCH METHODOLOGY

The methods used in this study include system requirements analysis, system needs, certainty factor method. In the early stages, the initial symptoms of tumor disease are determined along with the determined expert values.

Table 1. Symptoms and expert scores

No	Code	Symptom	Mark Expert
1	G1	Gradual headache become more frequent and more severe	0.6
2	G2	Nausea and vomiting without cause	0.2
3	G3	Memory disorders	0.6
4	G4	Seizures	0.4
5	G5	Tingling and numbness in arms or legs	0.4
6	G6	Visual disturbances such as blurred vision	0.2
7	G7	Related issues with the sense of hearing	0.2
8	G8	Balance disorders, difficulty moving	0.8

After that, weighting is carried out as in Table 2.

Table 2. Confidence weighting

No	Information	Weight Belief
1	Not sure	0
2	Don't know	0.2
3	A little bit sure	0.4
4	Pretty sure	0.6
5	Certain	0.8
6	Very sure	1

Then the percentage level of the range of possible values is designed as in Table 3.

Table 3. Percentage of conclusions

Level presentation	Probability value
0-50%	Little Chance or Small Chance
51-79%	Possibility
80-99%	Most likely
100%	Very Sure

The next step is to test the system with CF calculations, an example of the calculation can be seen in Table 4.

Table 4. Example of calculation

Symptom	Answer	Weight
Headaches gradually become more frequent and more severe	Certain	0.8
Nausea and vomiting without cause	A Little Bit Sure	0.4
Memory disorders	Pretty Sure	0.6
Seizures	A Little Bit Sure	0.4
Tingling and numbness in the arms or legs	A Little Bit Sure	0.4
Vision disorders such as vision blurry	Pretty Sure	0.6
Problems related to the senses hearing	Don't know	0.2
Balance disorders, difficulty when move	Very Sure	1

The basic formula for CF is as follows:

CF[H,E]=MB[H,E]-MD[H,E] CF[H,E]1=CF[H]*CF[E]

CFcombine CF[H,E] 1,2 + CF[H,E] 2* [1-CF[H,E]1]

CFcombine CF[H,E] old,3 = CF[H,E] old + CF[H,E] 3 * [1-CF[H,E] old]

From the known formula and weights, we can calculate the CF value as follows: CF[H,E] 1 = CF[H] 1 * CF[E] 1

=0.6 * 0.8

=0.48

CF[H,E] 2 = CF[H] 2 * CF[E] 2

=0.2 * 0.4

=0.08

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

= 0.4 * 0.4

= 0.64

CF[H,E] 5 = CF[H] 5 * CF[E] 5

= 0.4 * 0.4

= 0.16

CF[H,E] 6 = CF[H] 6 * CF[E] 6

= 0.2 * 0.6

= 0.12

CF[H,E] 7 = CF[H] 7 * CF[E] 7

= 0.2 * 0.2

= 0.04

CF[H,E] 8 = CF[H] 8 * CF[E] 8

= 0.8 * 1

= 0.8

Then combine the CF values

CFcombine CF[H,E] 1,2 = CF[H,E] 1 + CF[H,E] 2 * (1- CF[H,E] 1)

= 0.48 + 0.08 * (1-0.48)

= 0.48 + 0.0416

=0.5216

CFcombine CF[H,E] old,3 = CF[H,E] old + CF[H,E] 3 * (1- CF[H,E] old)

=0.5216+ 0.36 * (1 – 0.5216)

=0.5216 + 0.172224

= 0.693824 old 2

CFcombine CF[H,E] old2,4 = CF[H,E] old + CF[H,E] 4 * (1- CF[H,E] old2)

= 0.693824 + 0.64 * (1 – 0.693824)

=0.693824 + 0.1959526

= 0.8897766 old 3

CFcombine CF[H,E] old3,5 = CF[H,E] old + CF[H,E] 5 * (1- CF[H,E] old3)

= 0.8897766 + 0.16 * (1 – 0.8897766)

=0.8897766 +

= 0.9074123 old 4

CFcombine CF[H,E] old4,6 = CF[H,E] old + CF[H,E] 6 * (1- CF[H,E] old4)

= 0.9074123 + 0.12 * (1 – 0.9074123)

=0.9074123 + 0.0111105

= 0.9185228 old 5

CFcombine CF[H,E] old5,7 = CF[H,E] old + CF[H,E] 7 * (1- CF[H,E] old5)

= 0.9185228 + 0.04 * (1 – 0.9185228)

= 0.9185228 +

= 0.9217819 old 6

CFcombine CF[H,E] old6,8 = CF[H,E] old + CF[H,E] 8 * (1- CF[H,E] old6)

= 0.9217819 + 0.8 * (1 – 0.9217819)

=0.9217819 + 0.0625745

= 0.9843564 old 7

CF[H,E] old7 * 100 = 0.9843564 * 100

= 98.43564%

So that the calculation results are obtained using a certainty factor with a confidence level percentage of 98.43564%

4. RESULTS AND DISCUSSION

After the analysis and design are done, then the implementation or trial process will be carried out, so that the results obtained can be maximized. This brain tumor diagnosis website is built using HTML and CSS, and uses the JavaScript programming language. The form displays questions that must be answered by the user as in Figure 1.

Figure 1. Question page

After the user answers all the questions, the system will process the data using the Certainty

factor that has been implemented. An example of the diagnosis results will be displayed to the user as in Figure 2.

Figure 2. Diagnosis results page

5. CONCLUSION AND SUGGESTIONS

From the results of the software design, it can be concluded that the expert system for diagnosing brain tumors is able to provide information to users about temporary diagnoses based on the symptoms they have. This software can also help educate users about brain tumors. And utilizes the artificial intelligence learning method, namely the certainty factor. For further development of the expert system website for diagnosing brain tumors to provide benefits to users, there are several things that can be done, namely improving the appearance of the website to make it more attractive, adding more specific questions related to brain tumors so that the results obtained are more optimal.

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