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APPLICATION OF CASE BASED REASONING (CBR) METHOD IN DISTRIBUTION TRAFO DAMAGE EXPERT SYSTEM AT PLN UP3 BINJAI

Aris Wahyono[1], A M H Pardede[2], Rahmadani[3]
STMIK KAPUTAMA,
JL.Veteran, No.4A-9A, Binjai, Sumatera Utara, Indonesia
Email :aries.punk85@gmail.com[1] , akimmhp@live.com[2], rahm4dani@gmail.com[3]

Abstract

In the world of electricity, transformers are widely used, both in the field of electric power and electronics. The use of transformers in the electric power system is used for each of its needs, for example the need for high voltage in the delivery of electrical power over long distances. Electrical equipment transformers are expensive and are very vital equipment. If the transformer is disturbed or in an abnormal condition, there may be an unexpected temporary cessation of electricity distribution and will cause losses for PLN and consumers who use electricity by disrupting the activities carried out. The Case Based Reasoning (CBR) method is a case-based reasoning system that uses previous experiences or cases so that they can solve new problems or cases. There are several stages in the case based reasoning method, including retrieve, reuse, revise, and retain. Case-based Reasoning (CBR) collects previous cases that are similar to the new problem and tries to modify the solution to fit the new case. The basic idea of Case-Based reasoning is the assumption that similar problems have similar solutions. While this assumption is not always true, it does depend on many practical domains. Where the previous case experienced an overvoltage transformer damage, using the CBR method will look for similarities to the previous case with existing characteristics, the CBR method will look for the same case on the existing Knowladge so that the damage is quickly detected. From the characteristics of the damage that is on the transformer, it is easy to diagnose transformer damage using the CBR method and the results of the CBR method will find a ranking that is almost similar to the existing case.

Keywords : ***Transformer Damage, Decision Support System, CBR (Case Based Reasoning)***

1. INTRODUCTION

In the world of electricity, transformers are widely used, both in the field of electric power and electronics. The use of transformers in the electric power system is used for each of its needs, for example the need for high voltage in the delivery of electrical power over long distances. Electrical equipment transformers are expensive and are very vital equipment. If the transformer is disturbed or in an abnormal condition, there may be an unexpected temporary cessation of electricity distribution and will cause losses for PLN and consumers who use electricity by disrupting the activities carried out.

This study discusses the symptoms that occur in the transformer so that the symptoms of transformer damage can be detected by the symptoms that arise, as is the case with the symptoms that occur in transformer damage in general such as high temperatures, experiencing excessive voltage, improper impedance ratio. , power factor, experiencing high temperatures around the transformer and transformer oil runs out. From these symptoms, it is possible to diagnose transformer damage and resolve it quickly by knowing how the transformer is damaged.

The Case Based Reasoning (CBR) method is a case-based reasoning system that uses previous experiences or cases so that they can solve new problems or cases. There are several stages in the case based reasoning method, including retrieve, reuse, revise, and retain. Case-based Reasoning (CBR) collects previous cases that are similar to the new problem and tries to modify the solution to fit the new case. The basic idea of Case-Based reasoning is the assumption that similar problems have similar solutions. While this assumption is not always true, it does depend on many practical domains.

In the presence of problems encountered, the formulation of the problem is as follows:

a. How to solve a diagnosis or problem that arises from a distribution transformer malfunction made in an expert system using the Case Base Resoning (CBR) method?
b. How can the results of making the system replace an expert into a computer so that diagnosis is easier and faster?

The purpose of this thesis research, in the expert system of distribution transformer damage at PLN UP3 Binjai as follows:

a. To find out the diagnosis of distribution transformer damage so that it can be handled more quickly.
b. To design and implement an expert system with Case Base Resoning (CBR) method for distribution transformer damage.
c. To learn and know about Case Base Reasoning (CBR) method and expert system.

2. RESEARCH METHODOLOGY

2.1 DEFINITION OF EXPERT SYSTEM

In general, an expert system is a system that seeks to adopt human knowledge to computers so that computers can solve problems as usual by experts. A good expert system is designed to be able to solve a particular problem by imitating the work of experts. With this expert system, even ordinary people are also expected to be able to solve quite complicated problems. Where the truth can only be solved with the help of experts. For experts, this expert system will also help their activities as highly experienced assistants.

2.2 UNDERSTANDING CBR METHOD (*CASE BASED REASONING*)

Case Based Reasoning has been applied in many different fields. From the various application fields, it shows how wide the scope of CBR is, most of which are applications within the framework of artificial intelligence. Areas of application include law, medicine, engineering, computing, communications networks, plant design, finance, scheduling, languages, history, food/nutrition, route discovery and the environment. (Mulyana dan Hartati, 2009).

a. Stages of Case Based Reasoning

There are four processes that occur in the CBR method in solving problems, namely:

1) Retrieve

When a new problem occurs, the system will first perform the retrieve process. This process will carry out two processing steps, namely problem recognition and search for equations of the old case stress level problem that are stored in the database

2) Reuse

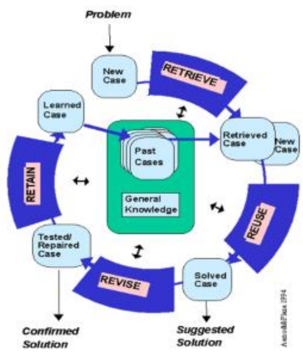
In this process the system will use information from previous stress cases that have similarities to solve new problems and reuse information and knowledge in these cases to solve problems. In the Reuse process it will copy, select, and complete the information that will be used.

3) Revise

In this process the information will be calculated, evaluated, and corrected again to overcome the errors that occur in the new problem. In the revision, the process of calculating the results will be evaluated directly by means of the calculation results of the similarity value of the new patient case being displayed again by the system.

4) Retain

This process indexes, integrates, and extracts new solutions. Furthermore, the new solution will be stored in the knowledge-base to solve future problems. Of course, the problem to be solved is a problem that has something in common with it. After retaining, the stored data of new cases in patient diagnoses will be used as a comparison (as old cases) in the next diagnostic process. The CBR cycle can be seen in the image below.



Picture II. 1 Cycle CBR

(Aamodt dan Plaza)

b. Type of Case Based Reasoning Method

Case matching, solution adaptation, and learning from experience can be guided and supported by an in-depth model of general domain knowledge. Some CBR methods consider a fairly large number of widely distributed cases in their case base, while others are based on a more limited one. Past cases can be retrieved and evaluated sequentially or in parallel. A term related to case-based reasoning.

1) Knowledge-based reasoning

It is a specialization of based reasoning which is the syntax of the Case Based Reasoning approach. Representations of simple examples are usually (eg feature vectors), because the main focus is to learn automatically in a cycle. Enterprise-based reasoning serves to distinguish more than existing methods-based examples of knowledge-intensive approaches.

2) Memory based reasoning

This approach emphasizes cases in large memory, and reasoning as a process to access and search in this memory. Memory organization and access are the focus of case-based reasoning methods. The use of parallel processing techniques is a characteristic of this method, and distinguishes this approach from other methods. Access and storage methods can rely on purely syntactic criteria.

3) Case-based reasoning

The case-based reasoning method has several characteristics that
differentiate them from other approaches. First, a typical case is usually assumed to have a certain degree of richness of information contained in it, and a certain complexity with respect to its internal organization. That is, the feature vector holds

multiple values and the appropriate class. Typical case-based methods also have another characteristic property that they are capable of modifying, or adapting, the solutions taken as they are applied in different problem solving contexts. The paradigmatic case-based method also uses a general knowledge background although the level of representation is explicit, and the role in the case-based reasoning process varies.

4) Analogy-based reasoning
The term is used as a synonym for case-based reasoning, to describe the typical case-based approach just described. However, it is also often used in characterizing methods to solve new problems based on past cases from different domains, while case-based methods focus on matching strategies to single case domains.

The formula for the CBR method to calculate the proximity between the two different cases is as follows:

$$Sim(T, Si) = \frac{\sum_{i=1}^{n} f\ (T, Si) x\ wi}{\sum_{i=1}^{n} wi}$$

T= New case

S = Cases in storage

n = Number of attributes in each-each case

i = Individual attributes 1 to n

f=Attribute similitari function I between case T and case S

Wi = Weights similar to absolute

2.3 DISTRIBUTION TRANSFORMERS

The distribution transformer is to increase and decrease the main voltage of the power distribution system for the utilization voltage of consumer use. The distribution transformer commonly used is the 20kV/400V step-down transformer. In the electricity distribution system in Indonesia, the voltage generated at the power plant is 13.8 KV. Then the voltage is increased to be distributed to the power transmission line by 150 KV.

The voltage on the transmission line, which is 150 KV, is lowered back to be distributed to the electricity distribution line by 20 KV. This 20 KV voltage is distributed to industrial consumers and household consumers. For household consumers, this 20 KV voltage is lowered back to 380 V for household use, namely 220 Volt AC which is obtained from a 1 phase to neutral voltage of 380 VAC. The phase-to-phase voltage of the low-voltage network system is 380 V. Due to a voltage drop, the low voltage is made above 380V so that the voltage at the receiving end is not less than 380V.

3. RESULTS AND DISCUSSION

In an expert system to detect damage to distribution transformers, characteristics or symptoms of damage are needed so that damage can be detected quickly. From the characteristics of the damage it will be able to detect what kind of damage has occurred in the transformer. This study discusses transformer damage such as overload, Loss Contact on Bushing Terminals, Broken Insulators / Broken Bushings, Low Power and Voltage Drops on Transformers.

Research supporting data

The variable requirements used in this expert system, namely distribution transformer damage data will be described in table III.1

Table III. 1 Distribution Transformer Damage

Damage Code	Damage Name
K1	Overloaded
K2	Loss Contact on Terminal Bushing
K3	Broken Insulator/Broken Bushing
K4	Low Power
K5	Voltage Drop in Transformer

There are several examples of symptoms of damage to the distribution transformer which are listed in table III. 8 describes the fault code, symptom code, symptom and weight. Symptom codes are used to represent what symptoms are experienced. The weight value of each symptom is based on the severity of the symptoms experienced, the determination of the weight value is given directly by the experts at the PLN UP 3 Binjai office.

Types of symptoms and weight

Table III.2 Symptoms Type

Damage	Symptom	Symptom	Weight

Code	Code		
K1	G1	Excessive heat	2
	G2	Decreased Work	1
	G3	Vibration in Transformer	3
K2	G4	Heat on transforme	2
	G5	transformer winding damage	1
	G6	Increased partial discharge activities	3
K3	G7	*Over voltage*	1
	G8	*Over current*	2
	G9	*Flash over*	3
K4	G10	Voltage drop	3
	G11	Flow down	2
	G12	Cable has dropped	1
K5	G13	Current decreases	1
	G14	Pusher Current decreases	3
	G16	The cable gets hot and catches fire	2

Value weight

In table III. 3 there is an explanation of the weighting value and an explanation if the weight value = 1 then the explanation is light.

Table III. 9 Weight Score

Weight Score	Information
1	Light
2	Currently
3	Dangerous

1. **Process *Retrive***

Table III. 4 Case Example Ks – K1

Case	Case New	Case Long	F (T/SI)
Ks – k1	Decreased Work	Excessive heat (2)	**0**
	Vibration in Transformer	Vibration in Transformer (3)	**1**
	Excessive heat	Excessive heat (2)	**1**
	Flow down	Flow down (2)	**1**

Table III. 5 Example Case Ks – K2

Case	Case New	Case Long	F (T/SI)
Ks – k2	Vibration in Transformer	Heat on transforme (2)	**1**
	Increased partial discharge activities	Increased partial discharge activities (3)	**0**
	transformer winding damage	transformer winding damage (2)	**0**
	Heat on transforme	Vibration in Transformer (3)	**1**

Table III. 6 Example Case Ks – K3

Case	Case New	Case Long	F (T/SI)
Ks – k3	*Over current*	Decreased Work (1)	**0**
	Over voltage	*Over current* (2)	**1**
	Excessive heat	*Over voltage* (1)	**0**
	Vibration in Transformer	Vibration in Transformer (3)	**1**

Table III. 7 Example Case Ks – K5

Case	Case New	Case Long	F (T/SI)
Ks – k1	Current decreases	Excessive heat (2)	**0**
	Pendorong Current decreases	Vibration in Transformer (3)	**1**
	The cable gets hot and catches fire	Excessive heat (2)	**0**
	Flow down	Flow down (2)	**0**

Calculation of similarity/similarity using the equation:

$$Sim(T, Si) = \frac{\sum_{i=1}^{n} f\ (T, Si) x\ wi}{\sum_{i=1}^{n} wi}$$

T= New case

S = Cases in storage

n = Number of attributes in each-each case

i = Individual attributes 1 to n

f=Attribute similitari function I between case T and case S

Wi = Weights similar to absolute

Ks – K1

Sim (T,Si) $= \frac{(0 * 2) + (1 * 3) + (1 * 2) + (1 * 2)}{2+3+2+2}$

Sim (T,Si) $= \frac{7}{9}$

= 0,77

Ks – K2

Sim(T,Si) $= \frac{(1 * 2) + (0 * 3) + (0 * 2) + (1 * 3)}{2+3+2+2}$

Sim (T,Si) $= \frac{5}{10}$

= 0,50

Ks – K3

Sim (T,Si) $= \frac{(0 * 1) + (1 * 3) + (0 * 2) + (0 * 2)}{2+3+2+2}$

Sim (T,Si) $= \frac{3}{7}$

= 0,42

Ks – K5

Sim (T,Si) $= \frac{(0 * 2) + (1 * 3) + (0 * 2) + (0 * 2)}{2+3+2+2}$

Sim (T,Si) $= \frac{3}{9}$

= 0,33

From the results of the similarity calculation above, the values obtained are K1 = 0.77 or 77%, K2 = 0.50 or 50%, K3 = 0.42 or 42% and K5 = 0.33 or 33% With the same calculation process, then the similarity between the new cases of Ks and the 4 cases that are already stored in the database are the following results in table III. 8.

Table III. 14 *Similitary*

Case	Similitary

Ks – K1	0,77
Ks – K2	0,50
Ks – K3	0,42
Ks – K5	0,33

The solution that will be given by the system in the new case is based on the similarity value that has been determined by the expert between the new case and the old case (reuse).

2. Process *Reuse*

In the rause process, the identification solution given is the solution that has a similarity value that has been determined by the distribution transformer expert. For the above case, the similarity result is in accordance with the standard determined by the distribution transformer, which is 0.50, then the damage is in K1 namely overload damage, with a similarity value of 0.77 or 77%, so that the solution for updating simulation parameters makes the results balance will be more accurate. By using a simulation program and the SBS method, the balancing results will be more accurate and effective and efficient in balancing energy and time.

3.* Process *Reuse

In this process the solution will be injected, integrated, and extract new solutions and then stored in the Knowledge base to solve the next problem.

4. CONCLUSION

From the description above, it can be concluded that the use of the Case Based Reasoning (CBR) method can solve and detect transformer damage easily by viewing and selecting existing damage and comparing with new cases, so that cases can be selected which match the events that have occurred. on the transformer with the help of malfunction symptoms.

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