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Expert System To Detect AC Damage Using Web-Based Backward Chaining Method

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Abstract

Air Conditioner or abbreviated as AC is one of the most widely used air conditioning devices in society today. Its ability to cool the room has attracted its users to help them get comfortable in carrying out their daily activities, especially during hot weather. Its simple form makes it can be installed anywhere according to user needs. The Berkah Sentral Service AC shop provides 2 AC technicians. The technicians must serve the problem of damage to all ACs, on average 1 technician can complete 5 AC services. If a technician receives a service call simultaneously, the customer waits in line until the other technician is finished. The problem that often occurs and takes a long time in handling AC Service is Freon. Therefore, an expert system is needed that can act as an assistant technician in analyzing AC problems. One of the most widely used search methods in expert systems is Backward Chaining. The backward Chaining Method used aims to trace the constraints that are displayed in the form of questions to diagnose the type of damage to the air conditioner.

Keywords: Expert system, Air Conditioner, Backward Chaining, Web-Based

Abstrak

Air Conditioner atau disingkat AC termasuk salah satu perangkat penyejuk udara yang paling banyak digunakan masyarakat sampai saat ini.Kemampuannya untuk mendinginkan ruangan telah menarik minat penggunanya untuk membantu mereka memperoleh kenyamanan dalam melakukan kegiatan sehari-hari, terutama pada saat cuaca sedang panas.Bentuknya yang sederhana menjadikannya dapat dipasang di mana saja sesuai kebutuhan pengguna.Toko Berkah Sentral Service AC menyediakan teknisi AC sejumlah 2 orang.Para teknisi harus melayani permasalahan kerusakan semua AC, dirata-ratakan untuk 1 teknisi bisa menyelesaikan service 5 AC. Jika teknisi menerima panggilan service secara bersamaan maka konsumen menunggu antrian sampai teknisi lainnya selesai. Masalah yang sering terjadi dan memakan waktu lama dalam penanganan Service AC yaitu Freon, Oleh karena itu, dibutuhkan sistem pakar yang dapat berperan sebagai asisten teknisi dalam menganalisa permasalahan AC. Salah satu metode penelusuran yang banyak digunakan dalam sistem pakar adalah Backward Chaining. Metode Backward Chaining digunakan bertujuan untuk menelusuri kendala yang ditampilkan dalam bentuk pertanyaan agar dapat mendiagnosa jenis kerusakan pada AC.

Kata kunci: *Sistem Pakar, Air Conditioner, Metode Backward Chaining, Berbasis Web*

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1. Pendahuluan

An expert system is a computer program that contains knowledge. This type of software was first developed by AI researchers in the 1960s and 1970s and was implemented commercially during the 1980s. Along with the development of technology, especially in the field of Air Conditioner (AC), AC problems often occur. For that there needs to be knowledge about AC damage, this is of course to improve the quality of service at the Central Berkah Store. The central blessing shop is a store that provides services for the sale and service of AC components in the city of Pekanbaru, Indonesia[1]–[3]. To speed up the process of identifying computer damage, an expert system for AC damage was created. By using this application every AC malfunction can be inputted into the program[4][5][6].

Air conditioning (AC) is a machine made to stabilize the temperature and humidity of the air in a room. This tool is used to cool or heat as needed. However, AC is often also called air conditioning because it is used more to cool a room. Willis Havilland Carrier was the first to invent large-scale modern air conditioners using electrical energy in 1902.

The AC Service Center Berkah Store provides 2 AC technicians. The technicians must service all AC damage problems, on average 1 technicians can complete 5 AC services. If technicians receive service calls simultaneously, the customer waits in line until another technician finishes. The problem that often occurs and takes a long time in handling AC service is Freon. Therefore, an expert system is needed that can act as an assistant technician in analyzing AC problems. The consumer will also be helped by this system because some components can be provided directly from the store, so consumers do not have to wait for the return of the damaged equipment to be picked up from the store. This application will become a technician's assistant because this system will provide information regarding the problems experienced by AC.

The expert system can provide problem information on the AC. With the way consumers operate the expert system application, problems or obstacles in the air conditioner will be informed by the application and will be confirmed to the technician. One of the most widely used search methods in expert systems is Backward Chaining. The Backward Chaining method is used to trace the obstacles that are displayed in the form of questions to diagnose the type of damage to the AC[7][8].

2. Research Method

Broadly speaking, research activities are carried out in three stages as follows:

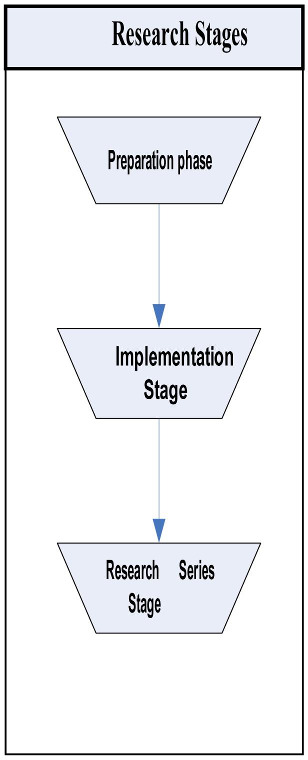

Figure 1. Research Stages

2.1. Preparation phase

Some of the preparations made are as follows:

a. Choosing a Research Theme or Topic. To choose a theme or research topic, a researcher must have a sensitivity to the life he faces[9].
b. Carrying out Preliminary Studies. In the research, the initial stage of the author is looking for the background of the research place.
c. Formulating research problems. From the results of the author's interview with the AC technician by looking for some obstacles and problems in the AC.
d. Determining Research Methods and Approaches. . The method that the author takes is based on journal references and conducts experiments on several methods that will be used[10].

2.2. Preparation phase

Research activity is a process of obtaining or obtaining knowledge or solving problems encountered, which is carried out scientifically, systematically, and logically. In research in any field, these stages generally have similarities, although some things often occur in the implementation of modifications. By the researcher according to the conditions and situations encountered without ignoring the general principles used in the research process.

2.3. Research Stage

The research stages are a series of stages or research steps. For publication purposes, research must be reported to interested people.

3. Results and Discussion

3.1 Analysis

The system analysis stage is a critical and very important stage in the development of processing a decision in determining the damage to the AC which is made using the PHP programming language and MySql database because at this stage an evaluation will be carried out on how far the performance of the system is running, identification of existing problems, Weaknesses, and barriers found, expected needs, and in the end, will come to the conclusion of the analysis that determines whether a system is worth developing.

3.2 Backward Chaining

The Backward Chaining method means using the condition-action rule set. In the Backward Chaining Method, data is used to determine which rules will be executed, then the rule is executed and sometimes there is a process of entering data into working memory.

a. Verification: Verification is a process that aims to ensure that the system is valid under specified conditions. The purpose of verification is to ensure there is a match between the system and what the system is doing and also to ensure that the system is error-free. The following are several methods of checking the rules in a knowledge base.
b. Redundant rules: It is said to be redundant rules if two or more rules have the same premise and conclusion.
c. Conflicting rules: Conflicting rules occur when two or more rules have the same premise but different conclusions.
d. Subsumed rules: A situation can be said to be a subsumed rule if the rule has more or fewer constraints but has the same conclusion.
e. Circular rules: Circular rules are a looping process of a rule because the premise of one rule is the conclusion of another rule or vice versa.
f. Unnecessary IF condition: Unnecessary IF occurs when two or more rules have the same conclusion but one of the rules has a premise that does not need to be conditioned in the rule because it does not have any effect.
g. Dead-end rules: Dead-end rules are actions that do not affect the conclusion and are not used by other rules to produce a conclusion.
h. Missing Rules: Missing rules are rules that are marked by facts that are never used in the inference process.
i. Unreachable Rules: Unreachable rules are rules whose premise will never match the state of the system, either because of missing rules/lack of input data.

3.3. Tree Diagram

The Trouble Shooting AC (Air Conditioner) Expert System Rules Base In this Air Conditioner Damage Detection Expert System has its Rule Base to determine the direction of the search or consultation that will be submitted. The basic rules are as follows:

IF Damage to { kind of damage } and

{ type of damage } and {Characteristics of damage and causes }

Then The solution, { problem solution } Example of Rule Base as follows.

If Damage to the AC compressor, AC becomes less cold, the compressor engine becomes noisy and the compressor gets hot fast.

Then the solution,

a. Check the AC Compressor and try turning off the fuse and turning on the AC.
b. The compressor must be serviced
c. Clean compressor pipe.

The following is a Decision Tree Diagram of an Expert System for Detecting AC Damage.

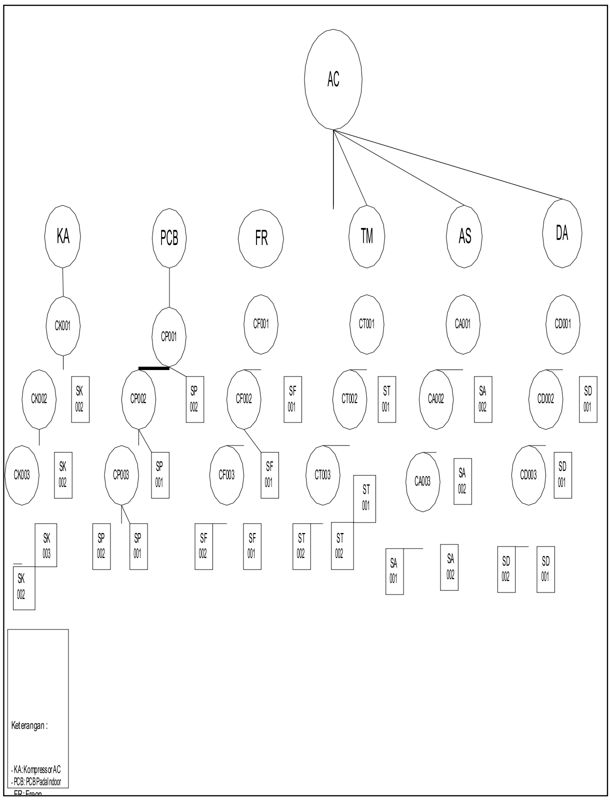

Figure 2. Decision Tree

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3.4. Expert System Architecture Detects AC Fault

This application is run by two users, namely expert users and general users. Expert users are users who have expertise in the field of AC, know the symptoms, causes, and types of AC damage, and can handle AC damage. General users are the general public who want to get help regarding the types of AC damage and their handling.

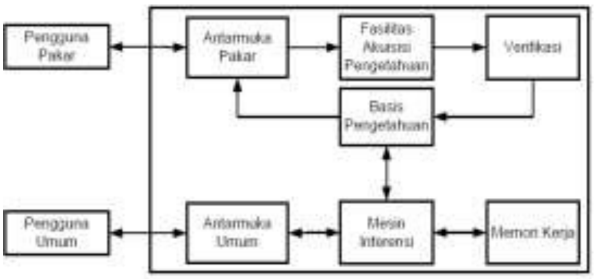

Figure 3. System Architecture

1. Disturbance Table

Table 1. Table of Supporting Software and Hardware

Table of Characteristics of Damage "AC Compressor"

Feature Code	**Disturbance Name**
CK001	AC becomes less cold
CK002	AC is not cold at all
CK003	Compressor engine becomes noisy
CK004	The compressor gets hot fast
CK005	Compressor engine buzzing
CK006	Compressor dead

Table of Characteristics of "Indoor PCB" Damage

Feature Code	**Disturbance Name**
CP001	AC doesn't turn on or turns off Completely
CP002	The fuse in the indoor is off

Table of Characteristics of Damage "Freon"

Type Code	**Disturbance Name**
CF001	AC gives off ice or becomes ice
CF002	AC is not cold
CF003	Cold but still hot

Table of Characteristics of Damage "Thermistor"

Feature Code	**Disturbance Name**
CT001	Outdoor AC often turns off and on
CT002	The fan turns on but doesn't come out Dew
CT003	The fan turns off but doesn't output Dew

Table of Characteristics of Damage "Aca sensor."

Feature Code	**Disturbance Name**
CA001	AC cannot be remote
CA002	The manual button works but the remote doesn't
CA003	Suhu stabil walapun di setting tinggi

Tabel Ciri-ciri Kerusakan "Drainase AC "

Feature Code	**Disturbance Name**
CD001	The air conditioner gives off water
CD002	The air conditioner comes out of ice or becomes ice and let out water
CD003	AC pipe releases Freon water

2. Solution Table

Tabel 2. Solution Table

Code	**Error Solution Table on air conditioning**
SK001	Check AC Compressor and try turn off the fuse and turn on the air conditioner
SK002	The compressor must be serviced
SK003	Compressor Broken
SK004	Clean the compressor pipe
SK005	Compressor IC problem
SK006	Compressor Components
SP001	Problematic Indoor PCB Components
SP002	Clean the components with a brush and clean with a dry cloth
SF001	Freon gas needs to be re-injected
SF002	Freon needs to be replaced
SF003	Freon needs to be serviced
ST001	Main component thermistor fault
ST002	Clean the dust on the thermistor
ST003	The thermistor needs to be replaced
SA001	There is a damaged AC sensor component
SA002	The Remote is broken and needs to be replaced
SA003	AC sensor needs to be replaced
SD001	AC drainage is broken and needs to be replaced
SD002	Outdoor AC and Engine Drainage Damaged
SD003	AC Drainage Service

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3. Tree Rules Table

Tabel 3. Tree Rules Table

Damage Table	**Damage Symptom Rules**
KA	AC becomes less cold
	AC is not cold at all
	Compressor engine becomes noisy
	The compressor gets hot fast
PCB	AC doesn't turn on or turns off completely
	The fuse in the indoor is off
FR	AC comes out ice or becomes ice
	AC is not cold
	Cold but still hot
TM	Outdoor AC often turns off and on
	The fan turns on but doesn't come out Dew
	The fan turns off but doesn't output Dew
AS	AC cannot be remote
	Manual button works but remote Not
	The stable temperature even at high settings
DA	The air conditioner gives off water
	AC comes out of ice or becomes ice and gives off water
	AC pipe releases Freon water

4. Decision Table

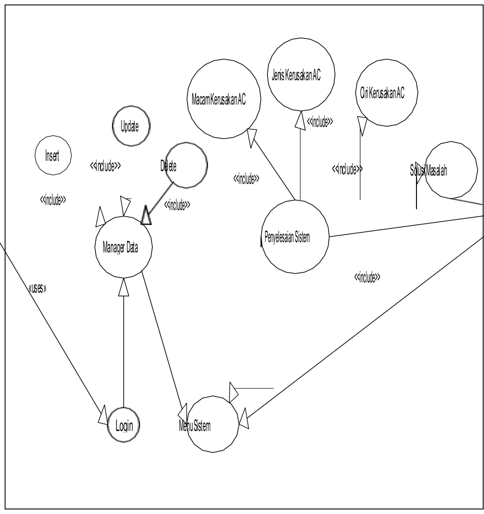
Table 2. Table Solutions

3.5. Design

The design of this application was built to make it easier for users to get information about the damage to the air conditioner they experienced, as well as make it easier for users to find solutions to the user's problems.

1. Model use case diagrams

This modeling is intended to describe the activities and relationships that occur between the actors and the use case in the current system.



Scenario *Use case* Admin

Table 5. Admin Use case table

use case Scenario	
Name use case	Expert System For Detecting AC Fault
Main Actor	Admin
Destionation	-
Type	*Primary*
Description	*Users can input user data that will analyze the application.*

Scenario Use case User

Table 6. Scenario Use case User

use case Scenario	
use case name	Expert System For Detecting AC Damage
Main Actor	*User*
Destination	-
Type	*Primary*
Description	*The user only determines, chooses a damage analysis which will be used.*

2. Class Diagram

Class diagram design is a technique to describe the relationship between tables in the database in the form of diagrams. In designing relations between tables, data entities will be described, relationships between entities and each attribute as well as the key attributes in the

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form of a diagram. So that the correct and complex database design will become easier and simpler to understand the relationship between entities with one another through one of the predetermined attributes.

Figure 4. Class Diagram

3. Implementation

a.. Login Display

The login form is useful for logging in to the application, here is the login data form:

Figure 5. Login Interface

b. Display of Damage Detection Diagnostics on AC

The AC damage detection form is useful for detecting the AC, here is the AC damage detection form.

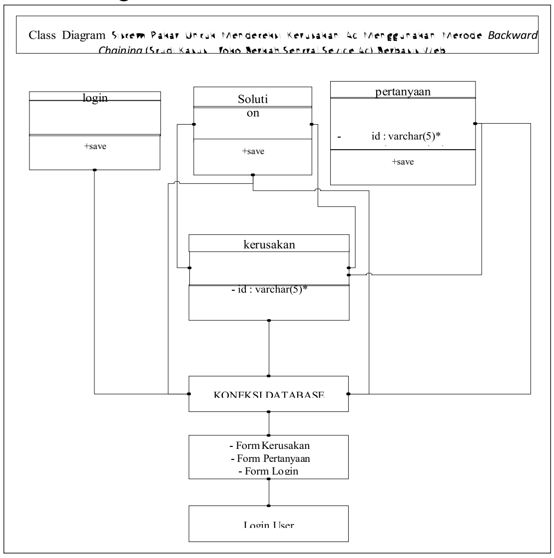
Figure 7. Air Conditioner Fault Detection Diagnostic Display

4. Conclusion

Based on the results of research and discussion in this study, the expert system for diagnosing AC damage can be concluded as follows::

1. The web-based Backward Chaining method can be used to assist AC technicians in dealing with problems related to AC.

2. The application can provide a diagnosis of AC damage and its solution.



3. Based on the results of application testing carried out on the user, it was found that the system can overcome the problem, in this case, the problem of damage to the AC.

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