DIAGNOSING COMPUTER HARDWARE FAILURES USING EXPERT SYSTEM (RULE-BASED TECHNIQUE)

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ABSTRACT : *This on-going study introduces a method that reduces the problems in diagnosing computer hardware failures. An expert intelligent system using the rule-based technique is introduced to diagnose computer hardware failures. The user or computer technician does not need to check parts of the computer hardware individually. They just need to key-in parts of the computer hardware and the symptoms into the system, and then it will diagnose the computer hardware failure. The development of the diagnosed computer hardware failure diagnosis using the rule-based technique is based on the expert system development methodology that consists of eight stages; Research and Review, Conceptualisation, Problem Assessment, Knowledge Acquisition and Analysis, Design and Implementation, Testing, Documentation and Management. The system will display the possible causes and suggest a solution. The rules of the proposed expert system are in the form of if-then statements. The rule-based system itself uses a simple technique and it starts with a rule-based, which contains all of the appropriate knowledge encoded into If-Then rules. Categories of rule in this system are an audio, Hard Disk, keyboard, mouse, power supply, processor, start up, Serial ATA, USB device, printer, motherboard, CPU, RAM, peripheral, BIOS, Video Monitor and adapter, DVD drive and DVD/CD recording.*

KEYWORDS: Computer hardware failure, expert system, rule-based

1.0   INTRODUCTION

Today, the demand for reliable computer systems continue to increase and many people face computer problems due to their inability to diagnose the actual problem; either software or hardware-related-failures. Hardware failures are most deadly because it affects our daily routine and our job. The widespread use of computers makes the computer hardware maintenance as a problem that cannot be ignored and must be solved. The causes of computer hardware failure are summarized and the specific maintenance methods are provided for diagnosing a computer hardware failures [1]. An expert system is introduced to develop a hardware for fault-detection for any computer system with many types of computer faults and it is divided into different problem modules [2]. The categories of computer problem are; computer hardware failure, damaged operating system, spyware, overloaded, viruses or browser hijacks. Computer hardware failure is the basic reason for several computer system failures in the industries and the majority of errors encountered on a computer are caused by hardware, and not software. Expert system (ES) is one part of AI, which is widely used as a solution provider to diagnose computer hardware failures [3]. Expert system is a computer program capable of performing at the level of a human expert in a specific problematic area such as computer hardware failures [4]. An expert system was designed to model the behaviour of an expert in some fields and use the same rules the expert would use to draw conclusions from a set of facts that are presented to the system [5].

2.0   THE DIAGNOSIS OF COMPUTER HARDWARE FAILURE USING EXPERT SYSTEM (RULE-BASED TECHNIQUE)

This on-going study introduces the methods of solving the problems to diagnose computer hardware failure and causes. Among the main problems are such as, the trouble of switching-on and off the computer, the trouble of crash, the trouble of display, the trouble of sound, the trouble of storage equipment, the trouble of CPU, the trouble of memory, the trouble of mainboard. Besides, this study introduces the how-to-classify the problems and solve the hardware failures. The purpose of this project is to find techniques to diagnose computer hardware failure and to help users, especially the computer technicians. Many people face these computer hardware problems, but they are unable to diagnose the actual problem. Usually, the user or computer technician takes a long time to identify the hardware problems.

2.1   The Current Approaches

A computer technician is a person who is responsible to repair the computer problems and a computer technician or maintainer must check every computer one-by-one and classify the hardware failures (see Figure 1). Usually a computer technician will take a long time to detect and identify the causes of computer hardware failure. This is the main reason why a computer technician needs this expert system to help them in managing daily operation The proposed system is intended to diagnose computer hardware failures and it will provide quick and optimum solutions for computer technician. The next subsection will explain the proposed system. Figure 2 shows the process on how a computer technician diagnoses computer hardware failure manually in managing the daily operation.

A computer technician must check every part of the computer hardware individually to diagnose computer hardware failures. If the cause of the computer hardware failures detected, the process will end and then a computer technician will repair the failures. But if the cause of the failures were not detected, the technician will go on checking another part of the computer hardware until the cause of the computer is being detected. This process will
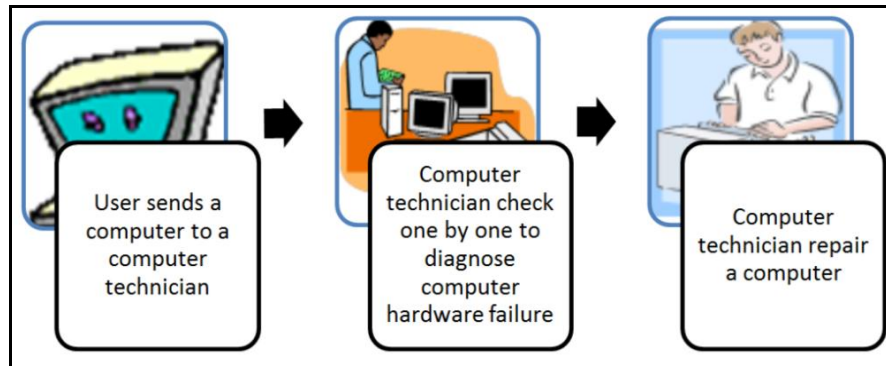
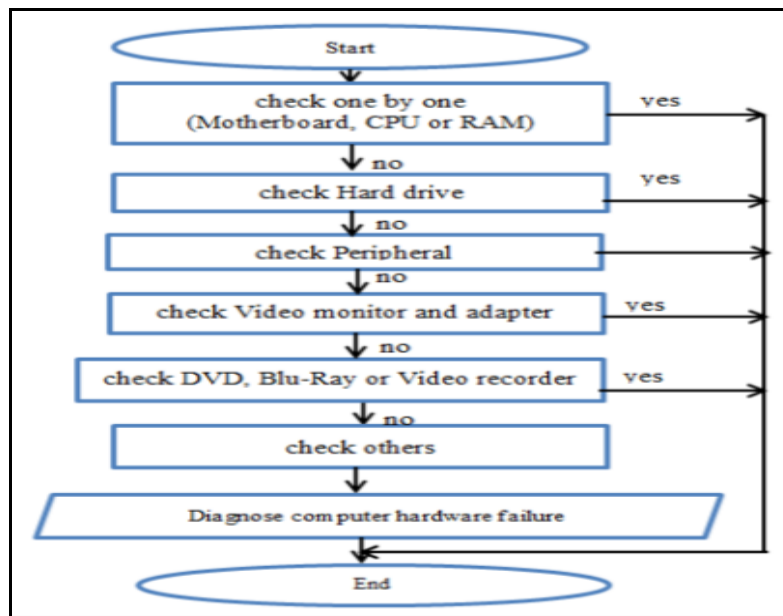**Figure 1:** Computer Technician Daily Operation

Figure 2: The Diagnosis of Computer Hardware Failure Manually Process

take a long time and add-up the time needed to complete the task as they need to repeat the same process.

2.2 Modelling of the Diagnosis of Computer Hardware Failure Using Rule-Based Technique

The main phases in the knowledge engineering process is the dialog process. This process is similar to the task of requirements of a system designer of the program, in which they usually discuss with the user or computer technician in a conventional programming. After acquiring the relevant knowledge, engineers have to explicitly transfer it into a model framework as shown in Figure 3. After that, it is converted into the expert system knowledge base. After the coding stage, the human expert evaluates the expert system and then gives feedback to the knowledge engineer. The phase in this process will be iterated until the human expert finds the system satisfactory [6].

2.3 Overview of the Diagnosis of Computer Hardware Failure Expert System

In this research, we propose an expert system to help computer technicians in making decisions and diagnosing computer hardware failure process. The intention is not to replace the function of computer technician but to help them. The computer technicians are still the people who will have the final say. The objective of the proposed system is to assist the computer technician to diagnose computer hardware failure for everyday operation. The proposed system aims to help computer technician to spend minimal time and make quick decision in diagnosing computer hardware failure. Figure 4 demonstrates the position of the new system. A computer technician represents the user of the proposed system and the box is identified as "Diagnose Computer Hardware Failure System" in the proposed system.

Figure 5 shows the process how a computer technician diagnoses computer hardware failure using the expert system. Computer technicians do not need to check every part of the computer hardware to diagnose computer hardware failure, but the users or technicians need only to key in the name of the hardware in problem along with its symptoms or facts into the system. The system then will diagnose the failure and display a cause before it can suggest a solution to solve that problem.
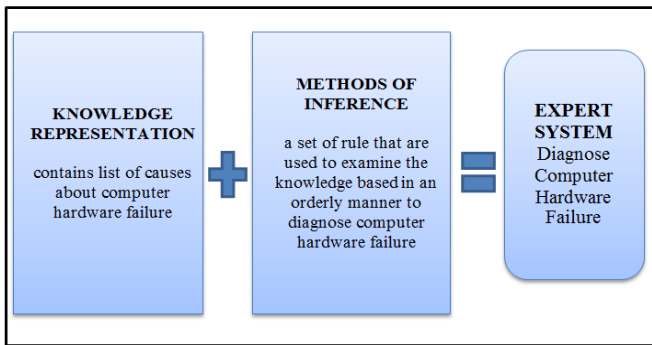
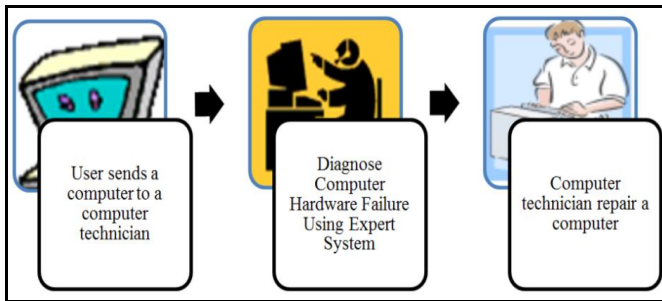**Figure 3: A Framework of the Diagnosis of Computer Hardware Failure**

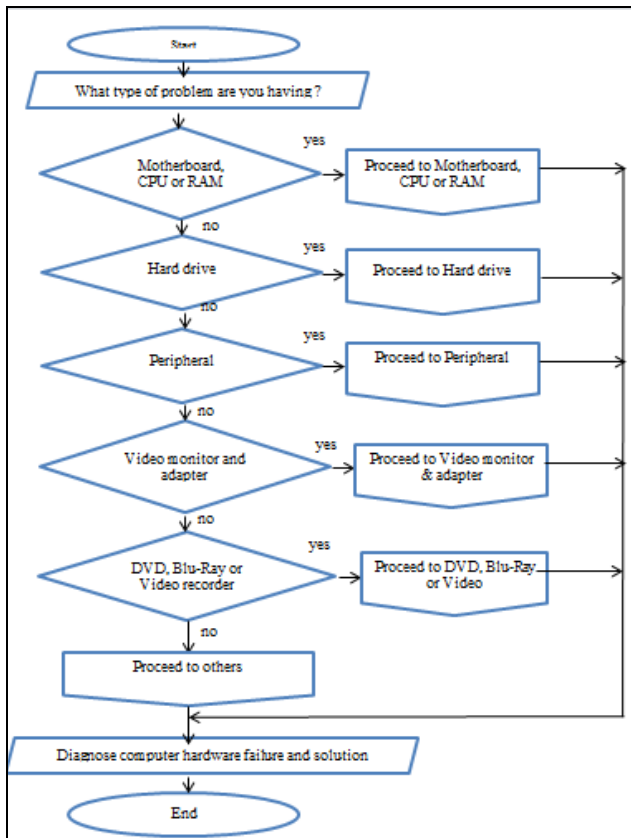**Figure 4: Proposed of the Diagnosing of Computer Hardware Failure Using Expert System**

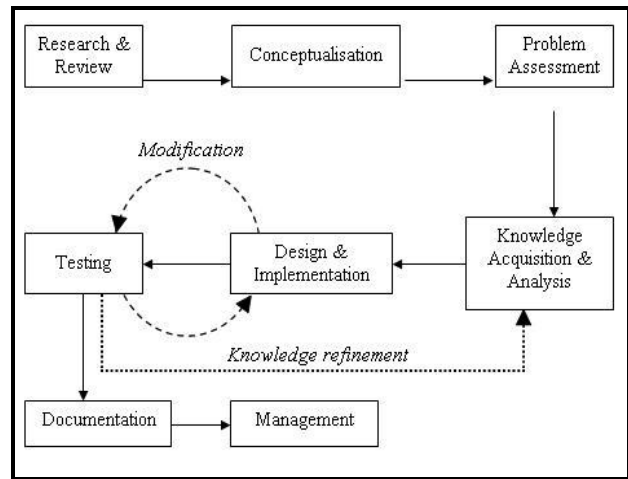**Figure 5: The Diagnosis of Computer Hardware Failures using Expert Systems Process**

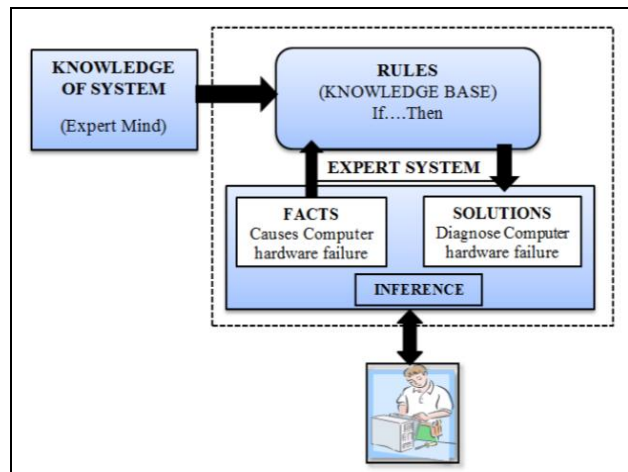**Figure 6: Expert System Development Methodology**

Figure 7: The Diagnosis of Computer Hardware Failures Architecture

2.4 Diagnosis of Computer Hardware Failure Using Expert System Development Stages
The development of diagnosing the computer hardware failure using a rule-based technique is based on the expert system development methodology which consist of eight stages; Research and Review, Conceptualization, Problem Assessment, Knowledge Acquisition and Analysis, Design and Implementation, Testing, Documentation and Management. Figure 6 shows the system development methodology in the expert system for the diagnose of the computer hardware failure.

2.5 Framework of the Diagnosis of Computer Hardware Failure
The expert system refers to computer software that attempts to act like a human expert. In cases, when a human expert is unavailable, the expert systems are often used to give advice to the non-experts. Figure 7 shows the Diagnosis of Computer Hardware Failure architecture using the expert systems consisting of three variables
namely, the inference, user interface and knowledge base. The rationale for proposing this framework is to help the user or computer technician to diagnose computer hardware

failure. A Framework of the Diagnosis of Computer Hardware Failure will then be checked by a group of specialists so that they can make evaluation and give feedback on the framework. The specialists group consists of the computer technician and officer from the information technology unit.

2.6 Rule-Based Technique

An expert system is a ruled-based artificial intelligent application program that provides expert quality solutions to problems in a specific domain [7]. When creating an expert system, the most difficult and expensive task is constructing a knowledge base [8]. The knowledge base is in the form of a partitioned rule base. The structure of the rules is designed in a manner that facilitates the domain knowledge representation [9]. The rule-based systems are also used in AI (artificial intelligence) programming and systems [10].

The rule-based system itself uses a simple technique and it starts with a rule-based, which contains all of the appropriate knowledge encoded into If-Then rules, and a working memory, which may or may not initially contain any data , assertions or initially known information. The rules of the proposed expert system are in the form of if-then statements, and it can be represented as **IF A AND B THEN C -> D** where A denotes the first condition, B denotes the second condition, C denotes the conclusion, and D denotes the solution. For instance, a possible production rule could be stated as follows: IF hard disk problem AND SMART warning displayed THEN serious mechanical problems are detected -> backup and replace your drive. Categories of the rule in this system are; audio, Hard Disk, keyboard, mouse, power supply, processor, start up, Serial ATA, USB device, printer, motherboard, CPU, RAM, peripheral, BIOS, Video Monitor and adapter, DVD drive, DVD or CD recording. **Error! Reference source not found.** is an example of a subset of the production rules stored in the rule-based.

3.0 FUTURE SCOPE

Despite the fact that the benefits of expert system using rule-based technique and building such a system is required for current needs, it is recommended that the system should be enhanced for future use. It is believed that this system has the potential to solve more hardware features in the future. In addition, it is recommended that this system should be made to work. Another thing that can be done in the near future is to deploy online programs in order to raise the usability of the system for users.

4.0 CONCLUSION

As a conclusion, the goal from building this simple expert system is to help computer users to diagnose computer hardware failure. Moreover, this application helps users to tackle some basic hardware issues or perform more extensive troubleshooting before seeking the assistance of the help desk or technicians.

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