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AN EXPERT SYSTEM FOR COMPUTER FAILURE DIAGNOSIS

Computer failure detection is a complicated process and requires high level of expertise.. This paper describes a proposed knowledge-based system for computer failure detection. The system structure and its components and their functions are described. The system has about hundred rules for different types of failures and causes.

Key words: *Expert system, computer failure. diagnosis, knowledge-based system.*

Introduction

Expert systems (ES) are a branch of artificial intelligence (AI), and were developed by the AI community in the mid-1960s. An expert system can be defined as "an intelligent computer program that uses knowledge and inference procedures to solve problems that are difficult enough to require significant human expertise for their solutions."[1] We can infer from this definition that expertise can be transferred from a human to a computer and then stored in the computer in a suitable form that users can call upon the computer for specific advice as needed. Then the system can make inferences and arrive at a specific conclusion to give advices and explains, if necessary, the logic behind the advice.

ES provide powerful and flexible means for obtaining solutions to a variety of problems that often cannot be dealt with by other, more traditional and orthodox methods [2]. The terms expert system and knowledge-based system (KBS) are often used synonymously. The four main components of KBS are: a knowledge base, an inference engine, a knowledge engineering tool, and a specific user interface. Some of KBS important applications include the following: medical treatment, engineering failure analysis, decision support, knowledge representation, climate forecasting..

Previous work has shown that systems concerned with computer fault detection were very limited.

There are a lot of related ES in the literature concerned with diagnostic problems. A knowledge-based system for computer failure diagnosis is presented in this paper.

1. Problem Identification

By the example of the functioning of the number of computer systems the possible reasons of their defects were investigated. The mistakes of the operators appeared to be the first reason of the system halt. Traditional measures of software and hardware reliability improvement are figured on the operators' correct actions.

But now in often happens that the system falls out due to their negligence and the time of the system standstill is longer than the idle time caused by the other troubles with hardware and software.

The proposed ES divides computer failures into three major types

The fig. 1 illustrates the percentage of the typical faults in the work of program-apparatus complexes which provide computer systems functioning.

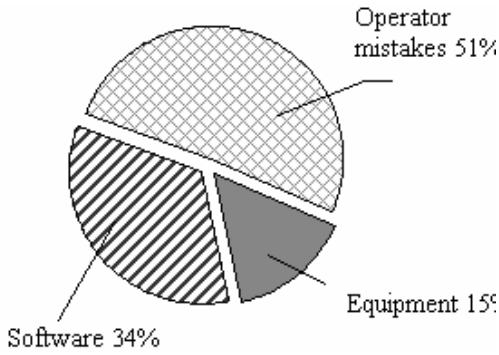

Fig. 1. The Reasons of computer systems faults

2. Problem solution

An general, the existing diagnostics systems (DS) based on the expert systems generally solve the problem of the detection of the fault and its appearance reasons in some CS or the process during information processing. During the process of diagnostics DS correlate the observed violations of the systems behavior with the reasons which caused these violations relying upon one of the following methods. In the first method the table of associative connections between behavior types and the diagnosis is used. In the second one the combined usage

of knowledge about the system structure and its unreliable parts, device realization or usable details allows to suppose faults which are compatible with the observed data. The necessity of comprehension of the structure of the systems which are diagnosed is the important specific of such problems. This problem becomes more complicated by the fact that some faults can be masked by the other ones. Besides, it is important to notice that the diagnostic equipment can also distort the registered information. At last, the structure of the system being diagnosed can be unknown or can be represented by the set of not always coordinated particular models. Necessary for the diagnostic process data can be unavailable or expensive or they can be connected with the destruction of the system being diagnosed, and this is one of the main problems of DS creation. And it is necessary to choose the optimal strategy of diagnostic information receipt in each concrete case.

The reduction of down-time and the liquidation of the bottlenecks of the CS with the help of automatic identification of irregular effects and automatic generation of the methods of their decision are the main purposes of DS. The system of expert analysis renders the diagnostic information of three categories:

The symptom is the event in the CS which needs the additional attention of the administrator. (Physical error when addressing to the network node or the single-repeated file transmission, for example). The symptom doesn't absolutely mean that the partial efficiency loss took place, but it requires administrator regard if the level of periodicity is high.

The diagnosis is the reiterated repetition of the symptom. It needs the compulsory analysis from the direction of the administrator of the network. As usual, the diagnosis describes the situations which characterize serious faults in the computer system (double network address, for example). At the diagnosis stage, the translation of the event leading to the partial loss of efficiency into the language which is understandable to the operator and the administrator takes place.

The explanation is the context-dependent expert conclusion of the analysis system for each diagnosis or symptom. The explanation contains the description of some possible reasons for the existing situation, the reasoning of such conclusion and the recommendations towards their elimination. The possibilities of supplement of the existing knowledge base by the specific data obtained by the administrator of CS in the process of its usage exist in the system.

But the efficient diagnostics of computer systems quires the solution of the complex of problems in accordance with the qualifying standards of the real-time systems [3]:

1. To represent varying in time data which incomes from the external sources; to provide the storage and the analysis of the changing data.

2. To fulfill temporary argumentation about several asynchronous processes simultaneously (i.e. to plan the handling of the processes got into the system in accordance with the priorities).

3. To provide the mechanism of argumentation in the conditions of the limited resources (time, memory). The realization of this mechanism makes demands of the high speed of the system work and the possibility to solve several problems concurrently (that is, we can use such operational systems as UNIX, VMS, Windows NT, but not MS-DOS).

4. To provide the predictability of system behavior. This will guarantee that each task will be started and stopped in the strict compliance with the time limitations.

5. To model the environment considered in the given application, to provide the creation of its various states.

6. To record its actions and personal actions, to provide the recovery after fault.

7. To provide the filling of knowledge base for the application of real degree of complexity with the minimal costs of time and labour. (The usage of object-oriented technology, common rules and the modularity is necessary).

8. To provide system tuning to the solving problems (The problem or object directivity).

9. To provide the creation and support of user interfaces for different user categories.

10. To provide information security level (according to the user categories) and to prevent the unauthorized access

The construction of the argumentations in the expert system is a rather complex and ambiguous process. The problem becomes more complex if the unstructured sets of data are used as the source information. The construction of the high-speed knowledge base is one of the main problems in this process.

3. Design and implementation of the KBS

The KBS developed in this work consists of the user interface, the explanation facility, the knowledge base, and the inference engine. The structure of KBS is shown in Fig. 2

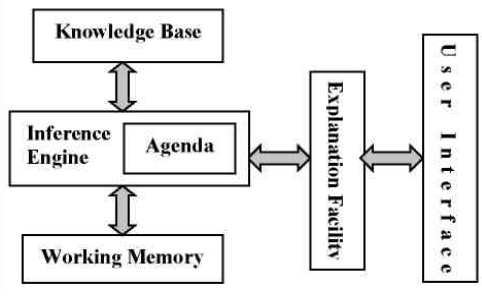

Fig. 2. Structure of the computer failure diagnosis system

*User Interface.*Communication between the user and the system is done through the user interface which implemented in English language. The user interface is represented as a menu which displays the questions to the user and the user answers with Yes or No. When the system is started a main menu is displayed on the screen which asks the user to choose one of the three computer states (Fig. 2).

*Explanation Facility.*Illustrates to the user how and why the system gave a certain cause for the failure, i.e. explains the reasoning of the language. The user interface is represented as a menu which displays the questions to the user and the user answers with Yes or No.

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*Explanation Facility.*Illustrates to the user how and why the system gave a certain cause for the failure, i.e. explains the reasoning of the system to the user.

*Knowledge Base.*The knowledge of the system is collected from computer experts, specialized books, and from different computer websites. The knowledge base contains about production rules for different types of computer failures and causes.

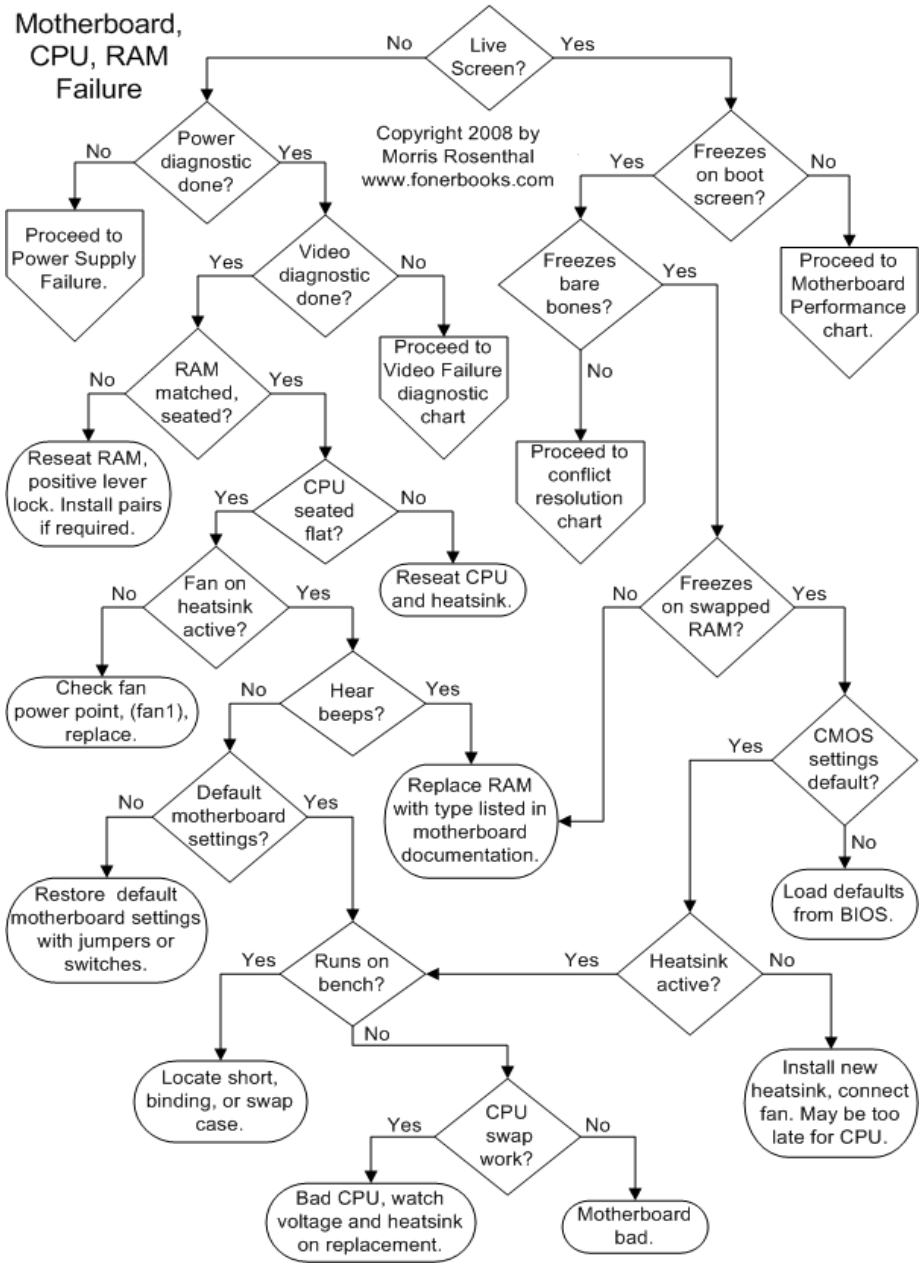

Fig. 3. Flowchart for motherboard

CS's are actually much easier to repair these days than in the early 90's. The average CS these days has less than a dozen parts, unless you start counting cables, and that total includes the keyboard and mouse! So, some new techs figure the way to learn computer repair and troubleshooting is to carry around a few spare parts and swap-til-you-drop. Well, it doesn't really work that way for a number of reasons, including the fact that all the really tough problems are intermittent, so diagnosing the problem correctly is actually the main challenge.

Computer hardware problems are less common than software problems, and there are far fewer variables to consider when learning to troubleshoot CS hardware. The real trick is to go about it in a systematic matter, eliminating possibilities whenever possible before you start purchasing replacement parts. To that end, a series of diagnostic flowcharts developed for logical approach to computer repair. Flowchart for motherboard is shown in fig. 3.

Results and Conclusions

We presented in this paper a KBS for computer failure diagnosis. The system consists of four main stages. We implemented the KBS using the CLIPS language. During the test phase of system it never gave wrong diagnosis according to the rules used. The system indicated that a full ES will be practical and can be extremely useful in providing consistent computer failure detection. Further work is needed to improve the system by adding sufficient domain knowledge that represents domain knowledge thoroughly. Plans are underway to convene experts to use the system to assist them in their jobs of computer failure detection. The first advantage of using CLIPS is it allowed us to keep the system small, while maintaining speed and ease of programming. The second important advantage of using CLIPS is the suitability of the forward reasoning.

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ЕКСПЕРТНА СИСТЕМА ДЛЯ ДІАГНОСТИКИ КОМП'ЮТЕРНИХ НЕСПРАВНОСТЕЙ

Механа Самі

Виявлення комп'ютерних несправностей є складним процесом й потребує високого рівня кваліфікацій персоналу Стаття описує експортну систему, яка базується на базі знаннь, для виявлення комп'ютерних несправностей. Описана структура системи, її компоненти та їх функції. Система має кілька сотен правил для різноманітних типів несправностей та їх причин.

Ключові слова: експертна система, діагностика, комп'ютерні несправності, система, база знань

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Механа Сами

Обнаружение компьютерных неисправностей является сложным процессом и требует высокой квалификации персонала. Статья описывает экспертную систему, основанную на базе знаний, для обнаружения компьютерных неисправностей. Описана структура системы, её компоненты и их функции. Система имеет несколько сотен правил для различных типов неисправностей и их причин.

Ключевые слова: экспертная система, диагностика, компьютерные неисправности, база знаний

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