A MAINTENANCE EXPERT SYSTEM

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We tackled the maintenance problem through an expert approach, from the view of the binomial human expert - expert system. Whether a human expert has knowledge in a specific domain, an expert system uses knowledge stocked in a knowledge base, joined in the respective domain.

According to the concurrent engineering principles, the paper presents the basic elements of a maintenance system expert designing and the adequate software. This last one being a component of an integrated software system, it is dealt with the system security: access levels, logging, signalling, user managing.

1. Introduction

On the one hand, the human experts reason and conclude on the basis of the knowledge they have, on the other hand, the expert system reasons using the knowledge base. In any case, the opinion of the cognition engineer is considered in designing and it is very clear that the process of the expert system designing is more effective if the human expert has information from the field of expert system technologies and methodologies.

Once the problem been solved and the solution been memorised, it is used at the resolving of other similar problems. The equipment maintenance problems belong to that category of problems for which is needed a relative long time and that are repetitive, therefore it yields to the expert system settlement [1]. A user friendly interface (natural language) facilitates the resolving of this kind of problems.

2. Problem statements and objectives

The expert system conceals the intrinsic formal aspects minuses, concerning of some formalism rigourless, through a user friendly interface. The perennial information and the cost diminution are other advantages. From the

point of view of the concurrent engineering methods, we set up the primary analyses:

- the concept fixing, through the establishing of the knowledge used by the human expert and the describing mode.
- the expert system features and performances establishing.
- the search criteria enunciating of the tools used in developing.

An appropriate maintenance activity is inconceivably in the absence of a CMMS-type informatic system (Computer-aided Maintenance Management System) which renders topical and monitors the correct usage of the information and offers reports fastly.

Moreover, it is proposed the making up of a maintenance expert system, including the facility to be trained by the human experts with the support of the cognition engineer [2].

3. Maintenance expert system

In a graph approach [3], we represent the *solving problems* by nodes, and the *inferences (problem solutions)* by arcs (as objects: oriented and labelled links).

We chose Object Oriented Programming as programming technique and Pascal as language, considering the Delphi environment usage. For the graph seeking optimisation are used the backtracking and minimum tree coverage methods [4]. Starting from a structure of concepts that can have a tree representation, the advancement to the leaf represents a specialisation, while the root proximity is a generalisation of the concept.

From the developing angle, the programs become conspicuous through:

- Object data positioning through functions with common structure for nodes and arcs.
- Program elements automatic set up (initialising, removing, saving/copying in/from files), once the functions from the previous paragraph being described.
- The possibility that these functions to return constant identifying values.

This architecture directs to:

- economical administrating of the memory.
- corresponding simplicity and legibleness.
- potential increasing of the support program.

4. Maintenance system security

The maintenance monitoring system is designed as a flexible and modular component of an integrated software system. In view of the network

connectivity of the software systems and consequently the potential access towards some confidential data, we put the problem of the *system security*.

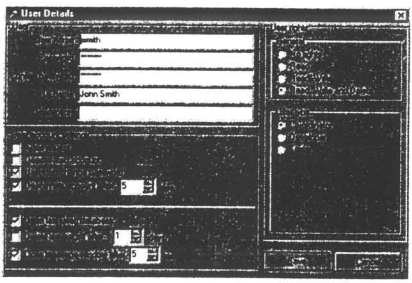

Fig. 1. *User Details* Window

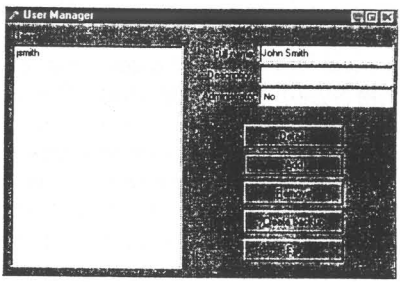

Fig. 2. *User Management* Window

Simultaneously, the security tool is very useful to successfully create and utilise access levels, with settable corresponding rights (fig. 1).

The access in the system is realised through username and password *logging*, in a special window of the software.

The system is also endowed with the signalling to the user of both the last successful entry and the failed entries. Admitting that a user try to get in the system with the account name of another user (being eventually on higher access level), the account proprietary receives at connecting a message as concerns the failed attempts - number, date, hour and, in case, if the wrong passwords contain characters which match to the correct one - so he has the data that would direct to the necessity of the password changing.

The administrator can use this support to transmit messages which, on a hand, could be cleared only by the each user, and on other hand, could not be cleared some number of days. In the same time, the system put on the administrator disposal a file with the events recording (users entries, fatal errors, correct logouts, finding password attempts) and a window for *user management* (fig. 2). As database engine, we choose Paradox due to the reasonable performance/cost ratio, relative to medium databases.

5. Algorithms and results

The modules for path minimising were applied in the cost minimising situations from the chosen maintenance policies. The available algorithms for system reliability measurement entail a calculation time $f(n)$, where f is at least exponential in n, the number of the system defectable elements [4].

In view of concurrent engineering principles, it was used the modularization as a decompose method of the reliability in a set of sub-problems. The minimum coverage tree (Kruskal) was also used [5]. The

algorithm builds step by step the lots T of minimal tree edges adding, at each step, the edge which do not form loops with the edges already been found in T.

The results are reflected in some computer programs: ConnexGraph, Minimum, TreeSelect, GraphGenerate, ListGenerate.

6. Future development

We intend to customise our system for the distributed tasks of an fault-tolerant software architecture. The results reflected in the present paper will be capitalised both as a forecasting tool and as a system security one.

With a view to the future application development, we consider the Oracle database system, because it is an open system and respects the industrial standards concerning the data accessing languages (SQL), it supports large databases, a great number of simultaneous users, it minimises the data access conflicts and it assures data concomitance.

7. Conclusions

For a data processing system at superior level, the essential element of the software system is the flexible knowledge base through that reasoning and forecasting are put at user's disposal through man-machine-date interface. At the moment, the expert systems are more and more direct associated with reasoning modes and represented knowledge. A large sort of our present research had in view the minimum in minimax strategies.

The maintenance expert system designing is facilitated by the construction of some general functions, aided by object oriented programming technique, used for the description both of the problems (the nodes) and of the inferences (the links between nodes), with effect in the treatment and program simplicity, in the optimisation of the available memory administration and in the extension of the program resources.

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