Expert Information System for Decision Support for the Problem of Diagnostics of Technical Condition of Buildings

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Abstract: *Objective assessment of technical condition of buildings is one of the main objectives of the system of technical supervision. Its implementation is based on periodic and unscheduled inspections of structures with identifying and fixing their flaws and faults, determining the extent of damage (wear) structures and further calculation that summarizes the condition of the structures with respect to their importance in the composition of the object on the technical condition of the latter.*

Keywords: examination, the technical condition of the building, an assessment method category.

1. Introduction

Under The construction or reconstruction of a residential facility, taking into account energy and environmental requirements, and improve the quality, reliability and reducing the complexity of construction works is the actual problem. At present the bulk of planning, construction and monitoring of buildings and structures are routine tasks, cyclically repeated with the necessity of processing and documentation of large volumes of information. Increasing requirements to the quality of decisions and economic responsibility for the results determine if Advisory, reference and optimizing systems.

The task of construction is a complex process consisting of a series of sequential steps and includes, for the weakly formalized (unwritten) and well formalized stages complex multi-objectives decision support.

Analysis of international experience shows that the development of systems of support of decision-making is the most promising application of the technology of expert systems (ES). All existing ES focused on solving a range of tasks in a narrow subject field and cannot be applied for solving the family, but not provided for in problems. Even for tasks that are included in the "competence" ES, an accurate diagnosis and finding the optimal solution is only possible if a similar situation was foreseen by the establishment of its knowledge base. An attempt to specify a knowledge base (KB) in the process of operation or to expand the range of problems that lead to change "logical order" BZ to the necessity of processing all the bundled software. [1].

2. The Problem

Feature of repairing building their production is weak formalization. Therefore, the main components of the development are logical blocks, which formalizes the knowledge of experts.

In ES modules to solve logic problems are the modules of the highest level. The result of solving the problem of the highest level is a "signal" to initialize one or more lower level modules, each of which solves a well-written task. At the same time, it is possible that any of the lower level modules in turn can have a two-tier structure.

Thus, the architecture universal hybrid ES includes:
- multi-level information knowledge base;
- multi-level database;
- tiered base facts;
- lots of modules that solve logic problems using appropriate levels of bases (the results of solving problems at this level manage the lower-level modules);
- lots of software modules of formal procedures (calculation modules - low levels of the system);
- coordination - a software package for solving problems of calculation of elements of design decisions" that uses for its operation, the required sections of the knowledge base.

The results of solving tasks of lower level modules use the highest level to assess the "quality" of the decision (feedback). In the process, for each phase of the decision-making process a particular method is selected based on the requirements of the class situations. The specific algorithm of decision making is formed in the process of interaction inference systems ES with the information stored in the knowledge base (in the Bank of heuristic rules or criteria of optimality) and heuristics, corresponding to the expert - user of the system. Moreover, the search space of the optimal solution depends on the degree of formalization of the problem: for a well-formalized tasks, the search space is uniquely determined by the knowledge base (Bank models or optimality criteria); for non-formalized problems the search space is largely dependent on the degree of processing heuristics and "heuristics". Provides the possibility of mutual "man-machine" training: expert trains the system (by clarifying heuristics or criteria of optimality); system trains users, while calculating and explaining the results.

Projected ES is a new approach to the problem of evaluation of technical condition and optimize the planning of capital repairs (reconstruction). The expert system is being developed to provide a rational structure for technical training of maintenance and construction production, reducing labor, reducing the duration and improving the quality of work and, thereby, increase the residual service life and reliability of buildings without increasing the cost of their repair or reconstruction [2].

3. Expert Information System for Decision Support for the Problem of Diagnostics of Technical Condition of Buildings

Expert systems are complex programs that use the accumulated knowledge with the aim of finding a satisfactory solution to a specific problem in the real world. The basis of the expert system is the knowledge base (KB) which is made during the process of its development and may be refined and expanded during use. The main difference ES from software systems and dialog systems is a full availability of all information on this problem, its automated search and analysis and also solution not only according to the data entered, but also taking into account all available information in the knowledge base and the archive system. For this ES contain: a crucial component of the problem, and the support component. The support component helps the user to interact with the main program and includes a convenient means of entering information, editing, analysis, control. These tools allow us to solve problems that are included in the "competence" ES anyone - even those without a sufficient knowledge of the problem and has no skills with a computer. Work under the technology menu and tips, using which you can carry out all calculations to analyze the real situation and to make a modification and extension of the knowledge base and archive system.

ES "Reconstruction of buildings" is an open knowledge base and repertoire of the best strategies and techniques used by the staff, continually updated to address specific tasks for the assessment of the real state and the optimization of repair (reconstruction) of buildings. When developing an expert system adopted the concept of a unified approach to all problems arising in the evaluation of the real state, the planning and conduct of repair (reconstruction) of buildings. ES "Reconstruction of buildings" is based on the hierarchical structure of the independent expert systems and hardware - software complexes. Each ES solves one or several technological problems associated with the diagnosis of a condition or optimization of reconstruction (overhaul repair) of buildings. Each ES solves the problem completely. After solving the problem, ES stores the results in the archive and on-demand user or ES a higher level gives in a convenient form for analysis. General block diagram of ES "Reconstruction of buildings" [3].

Lower level ES "Reconstruction of buildings" are expert systems, which interpret that use information from sensors or indirectly through expert operators monitor the real situation. ES, interpret, and deal with immediate real data, and with a clear symbolic representation of the problem situation. They face challenges which are not present in systems of other types, because they have to process information that is incomplete, unreliable or erroneous. They need special methods of registration parameters that provide sufficient accuracy and veracity of the information presented. In this case, conventional statistical methods are often inapplicable due to the lack of information.

ES, interpret and allow a preliminary analysis of the measured parameters according to the specified algorithm, to eliminate erroneous measurements or judgments, compress the information and submit it for further analysis in a convenient form. When analys the reliability and decision making use of knowledge accumulated in the database of the ES facts about controlled processes or special digital filtering algorithms. Reliability analysis based on the admission control and verification of consistency of information. To clarify the characteristics or data can be used methods of mathematical statistics and identification algorithms.

Example ES of the first level, interpreted, can serve as a software package that is being developed Database "housing Fund". Database "housing" is intended for fixing to structural features of all building systems and the changes that occurred as a result of operation. Fault detection is carried out in dialogue with an expert operator by filling out a special form and select the required information from the tables included in the fact base ES. Physical deterioration of each element of the building is determined by field examination and selection of characteristics in the relevant tables. Clarification of physical deterioration is carried out in the analysis of the percentage of defective areas to the total surface of the structural element and is fixed ES after the dialogue with the expert.

Reliability analysis based on the admission control. During full-scale tests can be used data from previously conducted surveys with clarification of the necessary information. This is a special mode copy the required information.

ES provides a variety of service tools that make working with available information. All collected in a database information on users ' requests or ES a higher level can be provided in a convenient form for analysis.

The second level ES "Reconstruction of buildings" is ES involved in the planning and optimization of repair (reconstruction) of the building. They determine the type and sequence of actions that will provide the required reliability and the required residual service life of the repaired building taking into account the real possibilities.

As a result of ES that level are calculated, the optimal timing, sequence and parameters of technological operations of repair work, and are also documented and archived the decisions taken and the work carried out.

The main objective ES of this level is to analyze the data on the real state of the individual elements of buildings, to identify the pattern of their changes (aging), to compare the residual life of each element with the required deadlines reliable operation and to optimize the parameters of the

reconstruction and repair of state-based requirements of the real situation.

The solution of this problem is to design the software system that is able to increase its functionality with the accumulation of information in the knowledge base of the ES. The first phase of development covers the problem of determining a real physical and moral deterioration of the building, forecasting its growth, the residual lifetime with recommendations for its repair or reconstruction.

The second stage is the optimization of the parameters of repair or reconstruction the selection of the task (analytical and simulation).

The basis of the ES serves as a wrapper that automates the process of providing the necessary information, provides \communication between levels and eliminates the possibility of occurrence of conflict situations in the processing of information. Shell expert system implements the functions of the "electronic assistant" and allows you to call and pass the necessary information between the individual subsystems and tasks that comprise them. The shell also allows for a phased development of the system by connecting new tasks when they are ready. The shell provides interaction with executable files and information, automates the search function, accumulation and presentation of necessary information for works and buildings. Each line of the shell corresponds to a particular type of work or a specific expert system. The settings of the shell is conducted during system installation, the parameters specified by the user. With shell you can arrange a convenient set of automated workplaces(AWP) of the main staff engaged in the repair and diagnosis of condition of buildings.

Continued research will help to develop the second level of the expert system, designed for planning and optimization of repair (reconstruction) of buildings. The main objective ES of this level is to analyze the data on the real state of the individual elements of buildings, to identify the pattern of their changes (aging), to compare the residual life of each element with the required terms of reliable operation, assign the necessary operations (major repairs, reconstruction) and to optimize its parameters based on the actual condition of buildings.

4. Conclusion

On the basis of the research formulated the basic principles of ES "Reconstruction of buildings" aimed at a comprehensive survey of buildings and the formation of recommendations on reconstruction.

Conducted theoretical research allowed to determine the approach and to develop a first level generic expert system "Reconstruction of buildings" intended for processing survey data, the determination of the physical and moral deterioration, assessment of the actual condition and remaining service life of buildings.

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