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Using of Expert Systems in Ventilation Systems Controlling

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ABSTRACT: In the paper results are presents of investigations on choice and justification of a type of computer system for control of mine ventilation systems in normal and abnormal conditions of exploitation.

I INTRODUCTION

Traditional formal mathematical models of mine ventilation systems not fully represent real object of control. This disadvantage compensates when using of principles of construction of expert systems (ES), which use experience and knowledge of specialists in specific field of activity. Presence at a market of software great volume of expert systems makes it difficult in choose the most suitable one. When comparing software with so various functions as expert systems, it is difficult to do any objective choice. That is why acceptable are, probably, three main properties of expert systems:

- potential of a system;
- easiness of development of databases;
- effectiveness and ease of operating of end user with designed application programs.

Working out of application expert systems, in our opinion, must be carried out with taking account of a fact that FS operating will be. at in particular conditions of a particular enterprise, where providing the main regimes of any system operating is possible.

2 DETAILS OF DEVELOPMENT OF EXPERT SYSTEMS OF MINE VENTILATION SYSTEM

All possible variants of mine ventilation system (MVS) behavior both in normal and abnormal situations are forecasted in accordance with United Safely Regulations. That is why there is no necessity for complex expert shell. During this ES development it is necessary to take account of behavior of the main system of safety ensuring - mine ventilation system. Designing computer system must use programs for calculation and control of air distribution in a system of mine workings both in abnormal situations (rock bumps, outbursts, cavings, fires and so on) and in normal conditions of mine ventilation system operating.

First of all, let's concentrate on properties of necessary information when creating ES on safety for mining enterprises, and define what they represent and with what purpose they are used. In this connection, bases of input data must include information about mine workings, which is presented as records that include the following fields: number in order, initial and end nodes, name of a mine working, value of perimeter of mine working, its cross section, marks of height of its start and finish, aerodynamic resistance, initial and final temperature on mine workings and so on. So database must include considerable volume of information. For example, mines of Kazakhstan operating today have about 800-900 mine workings, and entering information about them by foregoing positions will take considerable time and require intensive work of specialists of ventilation system management. However, when entering of information some data may be wrong, and this causes cycling of programs for calculations, receiving erroneous results, which do not represent real aerodynamic processes of mine ventilation system. Besides, on the basis of these calculations emergency control plan will be formed, and using it may have catastrophic consequences. For decreasing probability of mistakes during initial information entering, ES systems of control are provided. Databases have large mass of numbers. For verification of reliability of initial data programs ICXINFOR and WENTCHAR were worked out.

ICXINFOR program automatically carries out calculation of branches and nodes of ventilation system and testing presence of missed branches. Input file of this program includes number of a branch, initial node, end node. For printing table outputs, followings are included:

number of mine workings in ventilation system - LN;
number of nodes in ventilation system - YZ;
maximum number ol a branch in ventilation system - max V;
maximum number of a node in ventilation system - max YZ;
number of nodes of surface - YZ pov;
number of fans - NVEN;

- accuracy of calculations on air consumption - DQ.

In the process of operating, the program tests presence of missed branches. If there are such branches, the program outputs message: "Branches number ... are absent". If all branches present, the program outputs message: "Missed branches are absent".

For operating of program of forecasting calculations of air distribution in mine ventilation system, it is necessary to give characteristics of fans. For promoting of calculation of fans' coefficients, program WENTCHAR was worked out. For giving of curve of aerodynamic characteristic of any fan, it is necessary to know fan's type and angle of inclination of blades of the impeller of the fan.

Functions of ES program shell on maintenance of a user must be enough developed and ensure dialogue with the user in his language. They must have developed multi-level net of menu and lists of help on different problems of control of mine ventilation systems, give at a screen of display or printing explanation of taking one or other computer decisions in language, and must be comfortable for users. Let's study functions of ES program shell by above-mentioned positions. Besides, shell of expert system must take into account, that initiator of dialogue may be both itself and the user. In the first case ES passes to dialogue regime, if it detects the presence of discrepancies, which require revision of the user at any stage of ES operating. The second case is commanding for ES and this fully depends on the user wishes. Here ES shell must provide, that the user may give a command to ES transition to dialogue regime at any stage of formulated problem solving. So, when ensuring of dialogue regime ES program shell must functionally take account of two main positions:

1) two sources of initiating of dialogue regime: ES and user;
2) deformalization of current information up to language and terminology, comfortable for those users, who has no special knowledge in a field of programming and computer systems using.

Menu system, as a whole, may be presented as a tree, in root of which initial menu is located, representing, for example, kinds of emergencies at underground mining enterprises: fire, explosion, caving, rock bumps, water inflow, quicksand and so on. Every kind of emergency is a beginning of tree's branch with corresponding menu of different levels. For example, for emergency "fire" following menu may be a list of places of fire (ore yard, main workings, chambers and so on), then what is on fire (support, spontaneous ignition, cable, equipment and so on) and then condition of protective gears in lire conditions (ventilation system, fire-extinguishers and so on). The end top of a way on menu tree is shell transition to forming of initial information and decision of given problem.

Lists of variants of help for user ES uses at a stage of initial information forming after passing menu tree up to end top. For promoting of a search of necessary variants of help these lists may be structurally united also in a form of a tree, which is analogous to the menu tree, where this or that list of variants of help corresponds to specific menu.

The shell must functionally ensure output on display or printer current information about ES operation. User may do inquiry at any stage of problem solving.

Expert system "Safety" includes the following service programs:

- testing of correct input of initial data;
  testing of the first law of networks;
  data on mine air dams;
  program for calculation the coefficients of fans curves;
  program for view of calculated data.

3 CONCLUSIONS

On the basis of carried out investigations demonstration version of expert system "Safety" was worked out. This program product allows solving problems on calculation of mine ventilation systems both in normal and abnormal conditions. It was tested in practice and it is of interest for workers of ventilation service, mine rescue service and State mining inspection.