IMPROVEMENT OF QUALITY OF TRAINING AT BASE OF THE SOLUTION OF THE COMPLEX EDUCATIONAL TASKS

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Abstract. Questions of improvement quality of training students on the basis the solution of the complex educational tasks, challenge demanding complex use of knowledge gained in the course of training specialists on automation of technological processes and productions are considered.

1. Introduction

The current state of control difficult technological objects which thermal and nuclear power plants treat demands high qualification of operation and operational personnel and reliable operation of technical means of automation. Training of specialists in this area has the specifics consisting in need of acquisition of knowledge as according to the production technology, and methods and technical means of control.

The program of training specialists for automation technological processes and productions assumes development a complex special disciplines where special attention is paid to studying of the equipment and the final product made on it. Only based on knowledge and understanding of physical bases of production and operation of the equipment it is possible to speak about criteria of optimum control of this technological process.

2. Formal problem definition of training

Formal problem definition of training can be presented in the following form [1]: let $L$ be represented by a great number of the people trained in number of $n$; $J$ - a set of occupation characteristics (characteristics) of the person with total number of $k$ of signs. The element of a set $L_i \in L$ defines the specific person, and an element of a set $l_{ij} \in J$ - the concrete characteristic of the trainee. Then each trainee is characterized by vector $L_i(l_{i,1},l_{i,2}, \ldots, l_{i,k})$, defined on a set $J$ initial signs.

In the course of training it is required, to provide such level of training of the person at which the condition of $l_{ij} \in [\text{min}_j, \text{max}_j]$, for all $i$ is satisfied, where $\text{min}_j$, $\text{max}_j$ - respectively, the lower and top borders of range in which there has to be a value $j$ - oh characteristics of $i$ - oh the trainee.

The solution of a task breaks into two stages: preliminary and grade level.

At a preliminary stage it is necessary:

–to define a feature set of $J$ characterizing level training of the person according to duty regulations;

–to define requirements to level of training according to qualification characteristics, i.e. to set values of the lower and upper bound $\text{min}_j$ and $\text{max}_j$.

The grade level consists of the following steps:
– assessment initial values of the revealed set of signs (initial level of training);
– development of recommendations about individual preparation;
– training as a part of group on coinciding recommendations;
– assessment new values of the revealed set of signs the certain trainee (reached the level of individual preparation);
– development of recommendations about continuation of training or its termination.

Assessment the reached level of individual preparation is carried out by carrying out certification in the form of performance a control task, the test, examination, etc. At the same time the end of process training is made for its certain participant according to individual characteristics of the person on a condition of achievement of the required level training.

3. Requirements to level of training of the expert

Modern automated process control systems (Industrial control system) such object, difficult from the point of view of control, as the power unit, are under construction on the basis of the distributed control systems including the appropriate technical means which are carried out, as a rule, on the basis of the microprocessor equipment and local area networks. The basic principle of creation of industrial control system as is well-known, is the principle of hierarchy at which distribution of functions of control and decision-making between the operator and technical means of automation is carried out.

The role of technical means steadily increases that does not reduce responsibility of the person for functioning of system. At the same time creation of a hierarchical control system is the cornerstone functional groups of control - the elements allocated on certain functional or technological signs or some set of the equipment connected in a uniform complex and united by the purpose of optimum control.

Allocation of functional groups is connected first of all with the volume information and the operating functions necessary for acceptance and implementation the decision on control of the technological object control (TOC). Therefore, when forming control algorithms functional group and TOC in general it is necessary to study in detail structure information streams and to analyze the volume information shown to the operator in the most difficult situations.

It should be noted that in the modern control systems focused on use the distributed program and technical microprocessor funds and computer networks submission of information to the operator through video monitors with use of videograms and dynamically changing values of technological parameters is implemented. Via monitors also the operating actions of the operator, including control of actuation mechanisms, and also operation of automatic regulators and systems of logical control are implemented. At the same time there is a change functions of the operator in connection with redistribution tasks of control between the person and car.

One the directions of improvement of system training specialists on automation technological processes and productions is its reduction in compliance with modern requirements on the basis on intensive use exercise machines, and independent development the exercise machine in the course training means that provides fixing of the gained knowledge and skills in the specialty.

4. Set of knowledge for development of the exercise machine

Basis computer simulators of difficult technological objects are mathematical models which, as a rule, include models the physical processes happening in system, and also model technological automatic equipment, protection, blocking and control i.e. models of logiko-dynamic systems [2].

For creation such models it is necessary to have knowledge the mathematical description of objects, regulators, synthesis of systems automatic control, programming in one of algorithmic languages, ability to realize the user's interface including the main design stages of videograms static and dynamic elements, etc. That is, to have knowledge in the majority conforming to qualification requirements of the specialist in automation technological processes and productions.

Creation of models of logiko-dynamic control systems can is based on the basis a set of dynamic links and functional converters the analog and logical signals connected with each other definitely.
At statement an educational problem creation the exercise machine the teacher has to determine only output parameters of the created software product, i.e. define a circle of questions which the exercise machine allows to solve and the technical aspect of realization completely lays down on the student using knowledge gained in the course of training and putting them into practice.

One of the main requirements imposed to computer simulators is compliance of forms and methods access to information and governing bodies for real process and the exercise machine. An important point in the course creation the exercise machine is the way giving of process of training. Here it is expressed in creation of convenient, intuitively clear interface of the user (trainee). The developer has to realize that the trainee studies the subject domain, but not to how to work with the program exercise machine. In this regard it is necessary to solve a problem of a reconstruction of a workplace of the computer trained at the monitor with reasonable extent of abstraction from real and generalizations, i.e. to create a so-called virtual workplace.

Other important point is the possibility of use of active methods of training and motivational preferences of trainees. Therefore it is desirable to provide the moments of the choice of set of operating conditions of an object of control and realization of assessment of actions of the trainee in the form of text messages and/or quantitative assessment of his activity in the developed educational exercise machines.

Besides, development of communication systems does actual a task of distance learning through global networks when trainees and training (controlling) can be from each other at considerable distance. It promotes use of knowledge of gateway interaction of users, creations and uses of web resources and the appropriate information technologies of exchange of information.

Realization of computer simulators for new program technical means gives the chance to investigate features of application of these means before introduction them on an object.

It should be noted that for computer simulators similarity of model and the original can be reached without exact compliance in respect of realization of boards and control panels at obligatory information equivalence [3]. At the same time the new environment corresponding to functions and properties of subject domain in which there is an opportunity to realize activity of the person is created and an opportunity to add the determined algorithmic activity of the person operator regulated by rules and instructions of operation of an object, unformalized evristika - consequences of possible wrong actions of the trainee in the course of his operational activity is created.

When modeling technological processes and the equipment computing programs will be organized in the form of a set of separate program modules is information connected among themselves by data arrays (information streams).

Information communication between modules is carried out by formation in one module of the output massif containing results of calculation and its use as entrance data array for performance of calculations in other module. Feature of information streams in the computer simulator is continuous updating of the data arrays characterizing a condition of parameters the equipment in real time.

5. Experience of development of the exercise machine

Exercise machines within educational process can be created for such main objects of the heating equipment as:

- the major portions equipment of a block part of the station (direct-flow boilers, turbine units, network heaters, nutritious and condensation installations, etc.);
- the major portions equipment of a part of the station with cross communications (drum boilers, PT turbine units, the main and starting boilers, etc.);
- all-station equipment (peak boilers, circulating system, system of feed, gas distribution points, black oil economy, etc.).

Videograms of the heating equipment for computer simulators have to reflect the main design features and communications of the equipment without loss of adequacy of perception by trainees of the processes happening in the real equipment. Survey videograms of the major portions and service equipment (for example, the simplified thermal scheme of the power unit) with a possibility of the
choice of this or that site of technological process and the corresponding heating equipment have to be provided.

Example of development of the exercise machine is the performed task for degree design "The exercise machine of manual control" in which after the short description of the represented opportunities for control of a copper and the choice of a desirable operating mode, the videogram with the simplified thermal scheme of the power unit on which it is necessary to choose a copper for the subsequent manual remote control opens.

At the disposal of the user there are five blocks of remote control of executive mechanisms, influencing which it is necessary to support the maximum steam generating capacity of a equipment of TGMP-344A and respectively a power of the power unit, considering restrictions for changes of controlled technological sizes.

In the course of creation of the exercise machine knowledge of the following disciplines was used:

1) Computing systems and networks.
2) Boiler installations and steam generators.
3) Thermal power plants.
4) Programming of control algorithms.
5) Theory of automatic control.
6) Systems of automation and control.
7) Mathematical models of heat power objects.
8) Technical means of automation.
9) Planning of an experiment.
10) Optimum control of operating modes of the equipment.
11) Automation of technological processes and productions.

The provided list of disciplines shows complex use of knowledge gained in the course of training of specialists on automation of technological processes and productions at the solution of a problem of development of the exercise machine of control of the heat power equipment.

6. Conclusion

The decision students questions of development computer simulators for control of technological processes is the effective method training providing complex use knowledge gained in the course of training of specialists on automation of technological processes and productions at the solution of a problem of development of the exercise machine of control of the heat power equipment.

The questions appearing in the course development of the exercise machine not having standard ways of the decision promote development of informative and scientific skills of students that will undoubtedly be a basis of further activity of the expert.

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