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LOGICAL STRUCTURE DEVELOPMENT AND TESTING TASK FOR THE VIRTUAL TRAINING SIMULATOR AT THE GAS-CONTROL POINT START

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The requirements have been formed for the testing task algorithm of the virtual reality while training gas supply facility specialists. Possible ways for logical structure construction of the testing task have been considered. Problems connected with these ways have been analyzed. Concepts of the expert systems and neural networks have been considered. The way of projecting the algorithm has been justified. The conclusion has been made concerning the effectiveness of this way.

The virtual reality application for training gas supply facility specialists has been developed. It allows getting practical skills on the starting and expulsion the gas-control point (GCP). The customer has pointed the task during the project realization. According to this task it is needed to project the logical structure of the program, which covers the possibility of starting and expulsion of the GSP in different ways. GCP is the type of construction that can differ by configuration facilities and the way of plugging in the gas supply pipeline network.

All this factors can significantly affect the algorithm of the producible works. Consequently it is needed to develop the logics of the program with the possibility to adopt the algorithm to complete the tasks in the new GCP and new equipment in the short periods of time. One of the most important conditions to realize the algorithm is the task of the particular accordance of the technological instruction about the starting and the expulsion of the GCP. Even small mistakes that are made during the execution of these operations can lead to the serious consequences.

The requirement list that was presented to the algorithm was formed according to the earlier pointed conditions. First of all, the possibility of the algorithm to adapt easily to the different GCP configurations and its absolute accuracy by definition of the user's actions correctness. The requirements for the computational resources of the system should be minimal on the condition of using the virtual reality technologies and hardware limits of the equipment possibilities.

Traditional programming methods for achieving set goals are not suitable. The algorithm which is based on such a way is very hard to adapt to the different types of GCP. Its development takes a lot of time.

The algorithm creation on the base of graphs of the conditions is also not appropriate. It is necessary to anticipate and to describe all the possible options in the matrix, according to which an error was made. In this case it is necessary to make up such a graph for every GCP. According to this way there is a high probability of an error. This way also doesn't confirm the algorithm adaptability requirement and is not rational in the way of temporal expense.

It is necessary for this algorithm to imitate the course of reasoning the real expert in this activity area for the high-quality algorithm creation. In this case the algorithm should partly suit for the concept of "artificial intelligence". It is possible to point two ways for the developing the artificial intelligence, in particular, descending and ascending. Descending way means creation of the symbol systems, which design high-level physical processes such as thinking and reasoning. According to this way, the system should reproduce the logical reasoning course of the specialist in the particular subject area. Ascending way means learning the human's neural networks and creation of the similar models, which imitate intellectual behavior on the base of smaller "intellectual" elements.

The possibility of using the neural networks has been considered. Artificial neural network (ANN), which is more frequently called just neural network, is a mathematical or computer model. It was created by the principles of the biological neural networks work. In most cases ANN appeared as adaptive system that changes its structure on the base of incoming and outgoing informational handling, which is given at the time of learning phase. The popularity of ANN has reached huge success recently. They are used almost in every sphere of the human management.

In the case of high-quality training of the neural network, it could be appropriate to solve the pointed task. Unfortunately, the area that should be described by the algorithm is narrow and there is no data for ANN training. Consequently, neural networks training will require more temporal expense. Also algorithm adaptation for different GCP is made to face the problems that appeared while the overfitting of the neural networks. Overfitting is one of the deep neural network's problems. It consists of: the model that illustrates only examples from

the educative selection, and adaption to the training examples, instead of train to classify the examples, that are not in the training (with losing the ability to summarize). In the fact that neural networks do not make the logical conclusions, but just memorize regularities, it is not possible to guarantee what will be defined, and if the user made a mistake while starting the expulsion of the GCP or not.

This term appeared in the 1970-s because of expert systems as the alternative direction of the neural networks. Now neural networks and expert systems have been related to the artificial intelligence. This is absolutely different direction in the artificial intelligence sphere that is based on completely different principles and ways. Expert system (ES) is the program resource that uses expert's knowledge, for high-effective tasks solution in the subject area. [3]. ES was made for solving the important applications in the narrow knowledge areas. The main components of the ES are knowledge base and "tasks solver". Knowledge base contains data (facts) and rules (knowledge). Expert systems use rules to accept the solutions on the base of facts. Success of many projects that were based on this approach testifies that this approach is viable.

This approach has one more plus in the creation of algorithm. It is possible to follow the way of solving the particular ES by contrast with neural network, which appears as a black box. The use of ES lets adopt algorithm fast and easily for different configurations of the GCP. Main work principles should be described in the rules during the adaptation of the algorithm to the new GCP configuration. It is needed to describe rules only for different nodes. The description of work rules of the GCP and ES will help to define mistakes in the user's actions. It is thought that training the neural networks is a faster process than creating the ES. But in the conditions of the highly tailored area that needs data collecting and structuring, ES creating need the same temporal expense as neural networks, and maybe even better.

That's why the decision was made to divide the logical structure of the program on the knowledge base and ES. Knowledge base is constructed in the same way as the expert systems. It is divided into 2 sections: data (facts) and rules (knowledge). The fact has the form of the line in which all conditions have been listed. The last rule to write is a rule which should be completed in the presence of all requirement conditions. For example the rule: "if the gas before the regulator, regulator grip is lead up, crane on the impulse is closed, the mistake is done". Such rules are simple and understandable, that's why the system can easily show the user which mistake he made. The rule is a method that completes particular actions. After all actions ES verifies all the facts and stars suitable rules. If the fact was used it becomes inactive. If the condition from the fact disappears, the fact will become active again. All the facts have equal priorities except the facts that are connected with errors. Such facts have higher priority.

As a result of the analysis about different ways of creating the logical structure of testing task, we have come to the following conclusions. According to the requirements of the algorithm, the optimum way is to use the model of the logical structure that is based on the realization principles of the ES. Positive results have been received while testing the program product with the adjusted structure of the testing task. Speed work of algorithm conforms to the adjusted requirements. It completes on the control computer with the minimal speed of 0,001 second.

REFERENCES

4. Fandom [Electronic resource] .– Access mode: http://ru.science.wikia.com/wiki/Искусственная_нейронная_сеть. – Access date: 17.09.2018.
5. Habr [Electronic resource] . – Access mode: https://habr.com/company/wunderfund/blog/330814/ – Access date: 17.09.2018.
6. Инфопедия [Electronic resource] . – Access mode: https://infopedia.su.– Access date: 14.09.2018.