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СИСТЕМА СИГНАЛИЗИРОВАНИЯ В СИСТЕМЕ УПРАВЛЕНИЯ КОТЛОАГРЕГАТОМ НА ЭНЕРГЕТИЧЕСКОМ ПРЕДПРИЯТИИ

Из-за наличия на предприятиях каждый год проблемы хорошего качественного функционирования котлоагрегата возникает заинтересованность создать систему, которая в качестве своей задачи имеет своевременное оповещение об ошибках функционирования объекта управления. Поэтому в данной статье обсуждается создание усовершенствованной модели сигнализации для системы управления объектом и ставится вопрос о решении задачи осуществления безошибочного функционирования котлоагрегата. Данная модель включает в себя такие подходы к решению поставленной задачи, как методы искусственного интеллекта: генетический алгоритм и нечеткая логика. Нечеткая логика является отличным решением для создания современной, работающей должным образом и выдающей актуальные решения системы управления котлоагрегатом. Предлагаемая система может быть перенастроена для любого котла, в соответствии с условиями и требованиями его функционирования. В основу создания системы легла идея увеличение эффективности за счет ее удобства и гибкости.

Система управления; сигнализация; котлоагрегаты; нечеткая логика; самообучение; энергеические предприятия.

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ALARM SYSTEM FOR A BOILER SYSTEM CONTROL ON ENERGY ENTERPRISE

As the problem of good qualified functioning of a boiler every year is taking place, there is an interest to create an advanced error alarm system, which, as its mission, has the timely notification of the controlled object functioning errors. Thus, in this paper the improved model of the alarm system object control is proposed, the question of an error-free object functioning problem solving is raised. The proposed model includes such approaches to solve this problem as artificial intelligence: genetic algorithms and fuzzy logic. Fuzzy logic is the good solution to create a new modern, with proper functioning, and valid topical outcome from the system boiler control. The proposed system can be re-adjusted under any boiler, with different functioning conditions and working requirements. The main idea of this system development is to increase the efficiency by its convenience and flexibility.

Control system; alarm; boilers; fuzzy logic; self-learning; energy enterprise.

Alarm systems in the process industry play a key role in informing indications of abnormal process conditions or equipment malfunctions to the operators. Nowadays we can feel the need for designing, implementing and maintaining efficient alarm systems, which could additionally incorporate the signaling of learning optimal [7] and desired process conditions.

In practice, it is difficult to provide a precise mathematical description of the object control (OC) because of some external disturbances. That's why the development of automated alarm systems for the adequate mathematical model creation there is a complex mathematical problem. Moreover, the characteristics of the object during operation may vary substantially.

According to the object, which is called "boiler (heater)" this characteristics could be - pressure and flows, because of load changing by customers. It could happen in winter time, when a lot of people are trying to use their heaters. Another reason, which can also effect on boiler processing control, is the boiler fuel changing (oil, gas, and wood). Many boilers now are supported by different types of fuel. Also there are some another disturbances in such a complicated object.

According to those reasons, the object can fail sometimes, what is really bad for the boiler functioning and consumers. Under these conditions, the traditional methods are often inapplicable or just give poor results, which are shown in different literature [2, 7].

Thus, according to latest publications the systems, which will operate efficiently with partial priori-information, were considered. The idea is to give advices in different conditions of operation, during the operation of the facility in a control system; the system should work continuously while controlling.

In the construction of a complex object control alarm system in the absence of complete and accurate model of the object, it is possible to use several different approaches - fuzzy logic, self-adjust, optimization [1–4].

The field of artificial intelligence now embodies a broad range of tools and techniques that permit the presentation and manipulation of knowledge. It will continue to profound effect area such an alarm systems.

Techniques of fuzzy logic were incorporated because it is well known that operations and engineers often provide knowledge of their experience, in the form of rules. When we speak about accurate boiler control, which counts as the piece of art, because of its complicated structure, we choose fuzzy logic.

To do this, the analysis of the literature gathered from various libraries is provided. It was considered, which approaches are used to solve these problems nowadays. Through the convenience of Artificial intelligent the given task can be solved.

Fuzzy logic is an instrument for merging uncertainties and ad-hoc techniques into a mathematically sound method for logical inference. Hence, fuzzy control is appropriate in such cases of application. Real – time expert systems form the backbone of this idea. The issues of real-time expert system will play an important role in setting constraints and providing goals for the proposed continuous approach.

Using artificial intelligence techniques such as fuzzy logic can improve operator decision support that is why this in turn:

- can improve the performance of the boiler;
- increase of profit;
- can help to optimize operations.

As the diagnostic tool artificial intelligence can act the assistant to operator and help to monitor the process.

Fuzzy logic is the correct conceptual formalism for representing this form of knowledge. It captures both the natural continuity of fault evolution and the form of expert knowledge of the process in effect transforming a fault detection system into a real time diagnoses casting. The main advantage of the system is also its flexibility; it can be used on every working place, on the PC of operator, just need the initial right information for the running project.

Thus, the system is very useful in any plant with any working place, what is shown on the fig. 1.

There is one approach based on the search for extreme curve functioning of the process, was already considered earlier for the boiler control. The same scheme could be used for alarm system, which consists of data base, constructed by experts.

It is based on the following assumption, on the physical principle of the object. It is assumed that in the presence of extreme functions corresponding to the optimal (for a given criterion) the operation of the object are exists. So the search for extreme performance indicator is supposed to be provided, it should be done by analyzing the reaction of the object to the special search disturbances or natural disturbances by analyzing the state of the object. After the optimal has been found, as the main result is - the system can increase its efficiency, working in the direction to the optimum. Also, at the same time, another result is - the system's main feature is its flexibility with ability to be easy reconfigured according to new data, or another object [5, 6].

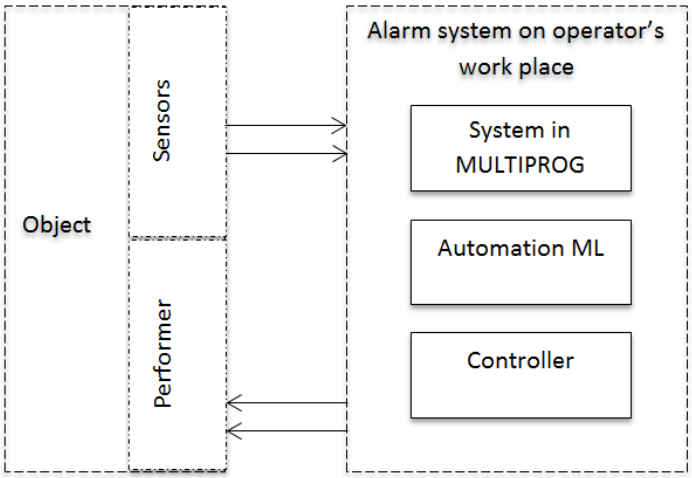

Fig. 1. Structure scheme

When the tendency to deterioration is taking place some alarm signals to the operator are needed. When the process has been developing in the direction of the accident, it`s acceptable to think that it's developing will continue linearly.

As the inputs usually the value of variable and on its changing speed (the depending on other parameters or between parameters) are used.

Alarm system should realize the opportunity the risk of bad cases before the boiler explosion, what is more important, and define the time before it comes. Hence, the system could be represented as situation model of alarms (different situations), inputs are: the value of variables, the value of its speed changing, the time intervals, to check the systems condition; outputs – advices with possible times before bad situation is taking place, what helps to operator react faster, and diapasons of those values, which were involved into that process.

In system all limits should be defined before, as it was mentioned: on absolute value (real axis could be fuzzy limit), on functional dependence of some parameters (within bounds [x,y]) and on solutions of the system.

So in the end we have an expert system with microprocessor, it produce not the decision, but an advice. It consists of a base inside system, but experts can fulfill it anytime, speaking about flexibility. It cannot teach itself, because otherwise we need a lot of accidents. In the case of prediction of these situations, we don't need the self-learning. But before operating system could be trained by special initial information – "bad cases" models.

The object of this system could be any heater (without natural draft, with forced ventilation), with output either water or electricity, the difference is only in the quality index. As quality index for adaptation heat productivity could be taken. Otherwise we can take a heat load or electricity load. So the system could be used for any plant, where re-adjustment take no place, it adapt itself.

For the model it is not necessary, it needs only a parameter and parameter could be any, even the position or the air choke. Regulating of a water flow – adjusting the position of a water supply valve, until system will work again as desired.

On identification stage it collects all potential alarms that are in accordance with principles outlined in the alarm philosophy. The alarm priority is also could be a part of system`s work.

A critical situation can often be recognized simply. Amount of data coming from different sensors, this information is processed simultaneously. Often the measurement are noisy and it`s sometimes difficult to determine if some abnormal signal waveform is caused by a fault of equipment or its external interference. In these cases fuzzy logic is the best decision. Its rule based knowledge is verified by experts, in rule sets situation boundaries are defined by sets of parameter value pairs. It could be adapted just by the training phase.

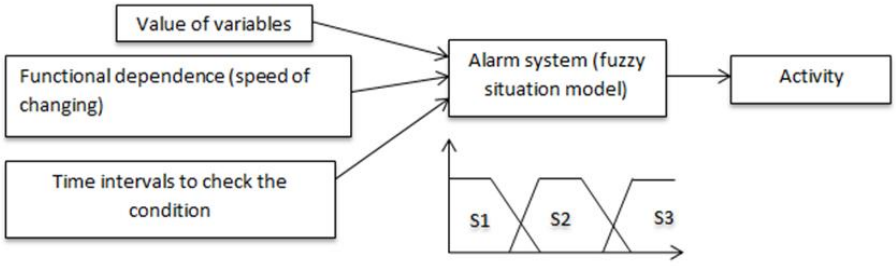

Fig. 2. System functioning plan

From the other side some “simulations” could be provided, that could be connected to the system, to check its work in cases of some faults. Those faults could be simulated. But this way is expensive, so we are going to use some models, which can calculate signals we are interested in, flows, etc. All kinds of faults can be modeled as well and signals can be measured. The derived set of equations describes the relations between values and then we get a model. When the model is complete and validated we can use it to provide knowledge for intelligent alarm system. But the developing of those models is the next step.

Coming back to the description, with initial data of characteristics we define the time boundaries, when operator still have time to change something in the system work to prevent a “bad” situation. If the border is crossed, system tells to operator the fact of increasing.

Inside of the model with the vector of conditions of the system prognoses the developing of the situation. If this situation (overheat, overflow, etc.) appeared – we get a signalization. Alarm systems already have initial information of combinations of parameters values for bad cases, analyze it, and give a signal.

To prevent false response of system also the statistics is collected, dispersion is calculated and checked.

In the end we have absolutely new model, which able to be updated, renewed, re-adjusted with new object or new conjunctions. The model includes new blocks, developed in Structured Text Language (IEC 61131-3 standard) and created especially for this model. The result of the creation is the one single system, adaptive, easy to set up, easy in usage and reconfiguration, which doesn`t require a lot of costs in the implementation.

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