Information Gaining and Processing System on the Basis of Two-Level Computer-based System

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Abstract
The analysis of structure of the two-level computer-based system for information gaining and processing system taken to account major system factors: technical (computer characteristics), informational (entrance information volume) and reliable (faultless operation parameters and system maintainability) for the account of power resources and an approach which allows essentially to save money resources and to raise authenticity of the accepted information is considered.

Keywords: control systems, information systems, computer applications.

During creation the majority of information gaining and processing system it is necessary to solve the system structure creation problem. There are two possible options: simple single-level systems "sensor - computer" (usually with digital pulse code), and the more perfect multilevel systems of gaining and processing information shown on the Figure 1: "sensor - computer for data gathering (DDG) – computer for control".

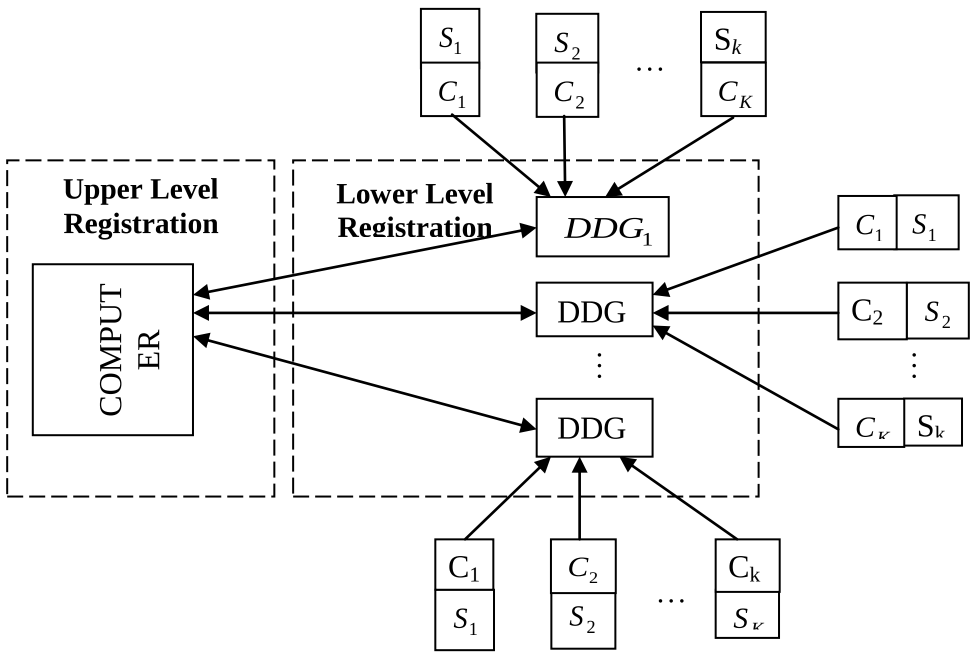

Figure 1 Two-level computer-based system scheme

The information from sensor by way of a pulse signal is determined as the certain norm spending of power resources. The final decision is accepted on the basis of analysis and required control requirements.

The system structure choice for information gathering and processing is characterized by the following major factors: technical (computer characteristics), informational (entrance information volume) and reliable (faultless operation parameters and system maintainability).

Two-level structure for gathering and processing information on the basis of the computer-based system can be presented as shown on Figure 2. In such system all sensors are supplied with digital converters (C) which generate impulses on DDG. Each impulse reflects the certain norm of current information. Furthermore, the DDG (lower level computer) consistently interrogates all the gathering channels, to keep the information from sensors, and to process the information on the basis of the appropriate algorithms.

The two-level computer-based system for power registration (Figures 1 and 2) consists of s .q sensors (micro-computer of lower level) and one top-level computer. Each of DDG presents $k = s/q$ places at the registration at k quantitative power system parameters. If power information consequence is taken into account, one can accept a minimum of average information quantity by of J for number k (or q) to total among of information.

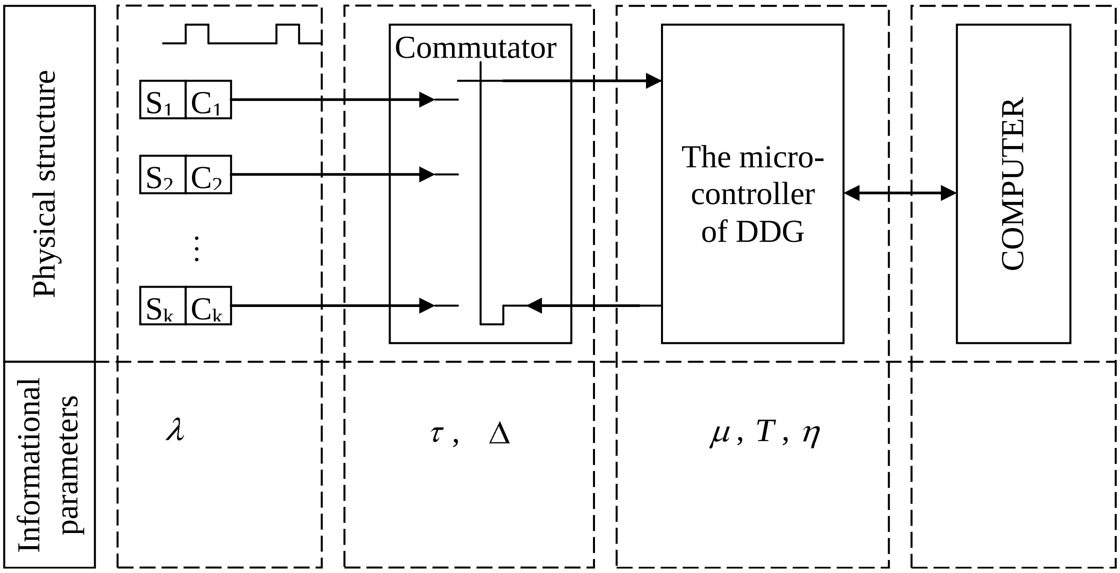

Figure 2 Two-level computer-based system structure of power resources

Let J_1 be an average share of breakages from k which can lose during trouble-free functioning of the two-level computer-based registration system. The impulse from these sensors defines the current consumption of the certain norm of power resources. Therefore, a time interval Δ (between consecutive inquiries for each sensor) is $\Delta = k \cdot \tau$, where τ - time interval between inquiries of adjacent sensors. The magnitude τ is defined by response speed of DDG. Furthermore, we shall suppose that this magnitude is constant. Assuming that the time intervals between information portions arrived and maintenance time (new information on the channel) up to the moment on the channel are distributed according to exponential laws with parameters λ and μ . Such assumptions do not contradict the accepted well-known conditions. The size λ is defined experimentally. The size μ depends on a transmitted data intensity (the more a transfer speed, the less should be a time of data observation in the channel). Parameter μ or its reverse size $T = 1/\mu$ represents an average delay time of information registration on the gathering channel. It is defined on the basis of direct supervision or with the help of mass service system model.

With the accepted assumptions the probability p information losses on one inquiry interval Δ is defined as follows as

$$p = p_{00} \cdot p_{10} + p_{11} \cdot p_{01}, \qquad (1)$$

where p_{00} - probability of a time interval Δ without the information; p_{11} - probability of the opposite event; p_{10} - probability of arrival and service (registration, observation) information portions in time Δ; p_{01} - probability of service information portion and arrival of new information portion in time Δ.

The equation (1) does not take into account rare events appropriate more than two pairs of "registration – service" of information portions:

$$p_{00} = \frac{\lambda}{\lambda + \mu};\ p_{10} = \int_0^{\Delta} \lambda \cdot e^{-\lambda t} \cdot \{1 - e^{-\mu \cdot (\Delta - t)}\} dt \quad p_{11} = \frac{\mu}{\lambda + \mu};\ p_{01} = \int_0^{\Delta} \mu \cdot e^{-\mu t} \cdot \{1 - e^{-\lambda \cdot (\Delta - t)}\} dt \qquad (2)$$

Provided that the sizes are small (an order is not above Δ^2)

$$p = \frac{\lambda \cdot \mu \cdot \Delta^2}{2}. \qquad (3)$$

Average losses of unregistered information about the spent power resources on all zones s are assessed by the equation (3) for a long operating time T_p as

$$n_1 = \frac{T_p \cdot p \cdot s}{\Delta} = \frac{\lambda \cdot \mu \cdot \Delta \cdot s \cdot T_p}{2}. \qquad (4)$$

The average of breakages is assessed for service zone in time T_p as

$$n_2 = T_p \cdot n \cdot \lambda. \qquad (5)$$

Thus

$$J_1 = \frac{n_1}{n_2} = \frac{\mu \cdot \Delta}{2} = \frac{\mu \cdot \tau \cdot k}{2}. \qquad (6)$$

Let J_2 be an unregistered information share at the exponential distribution law for both faultless operation and restoration modes.

As far as the idle time at one DDG, $k \cdot \lambda$ impulses, and T_p time for the average number of unregistered impulses is defined as for items having an order not higher η^2

$$n_3 \cong T_p \cdot k \cdot \lambda \cdot \frac{\eta q + 2\eta^2 q(q-1)}{1 + \eta q + 2\eta^2 \cdot q(q-1)} \cong T_p \cdot q \cdot k \cdot \lambda \cdot \eta \cdot [1 + 2\eta(q-1)] \cdot (1 - \eta q) \qquad (7)$$

Therefore

$$J_2 = \frac{n_3}{n_2} = \eta \cdot \left[1 + q \cdot \left(\frac{s}{k} - 2\right)\right]. \qquad (8)$$

and a general share of unregistered breakages is determined as

$$J = J_1 + J_2 = \frac{\mu \cdot \tau \cdot k}{2} + \eta \cdot \left[1 + q \cdot \left(\frac{s}{k} - 2\right)\right] \quad . \quad (9)$$

The number of places which has on one micro-computer and provides a minimum J is found from (9)

$$k = \eta \cdot \sqrt{\frac{2 \cdot s}{\mu \cdot \tau}} = \eta \cdot \sqrt{\frac{2 \cdot T \cdot s}{\tau}} \quad . \quad (10)$$

Thus, the found formulas (9) and (10) allow to define an optimum operative range for one DDG on the basis of four generalized parameters which characterize a system as a whole: η - reliability parameter of DDG, τ - throughput parameter, J - parameter of service system (sensor of DDG), ƨ - general number of controllable places in a system. In addition, equation (9) is right in the cases of a sliding quantity reserve for one DDG micro-computer as well.

Such approach for information gaining and processing system on the basis of two-level computer-based system with using formulas (9) and (10) taken to account major system factors: technical (computer characteristics), informational (entrance information volume) and reliable (faultless operation parameters and system maintainability) allows effectively to use computing and hardware in the computer-based registration power resources systems of objects and gathering and processing information for them. It allows essentially to save money resources and to raise authenticity of the accepted information.

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