безотказной работы схемы, состоящей из n последовательно соединённых элементов, или состоящей из m параллельно соединённых элементов [3]:

$$R_0 = \prod_{i=1}^{n} p_i \; , \; R_0 = 1 - \prod_{i=1}^{m} (1 - p_i)$$

где n, m − число элементов в схеме; p_i − вероятность безотказной работы i-го элемента.

Предложенный нами алгоритм основан на использовании «метода разложения сложной по структуре схемы относительно группы базовых элементов», в этом случае мы находим все возможные состояния схемы, затем используя метод минимальных сечений, выбираем те которые приводят к успешному функционированию схемы.

На кафедре ЭПГ разработана программа, которая позволяет использовать предложенный алгоритм, и определять минимальное и точное значение функции вероятности безотказной работы схемы в течении времени t с учётом двух типов отказов: отказ типа «обрыв цепи» и отказ типа «короткое замыкание».

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SYSTEMS OF SIGNALING IN THE MODERN AUTOMATED TECHNOLOGICAL PROCESS CONTROL SYSTEMS

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Quality of work of the automatic control systems (ACS) is determined by efficiency of algorithms and reliability of the program-apparatuses providing, faultless and productive work of the automated control systems by technological processes (ACS TP) in a great deal depends on correctness of operators-technologists actions. In the turn there is speed, exactness and infallibility of operator work to ACS by the most direct appearance depend on carefully thought out of human-machine interface (HMI).

One of the most essential functions of the HMI systems is information of operator about events requiring his interference.

On the determination offered international associations for the ISA standardization, signaling is the sound or visual mean of operator notification about the defects of equipment, declinations during a technological process or nonpermanent situation requiring interference. On the subsystem of signaling two basic tasks are laid:

1. To come into notice of operator to the fact of event offensive requiring the necessity of interference for work of the control system.

2. To give to the operator initial information about this event for the analysis of situation and subsequent acceptance of decisions.

Additionally the subsystem of signaling can report in an electronic or paper kind facts and switch-on time, switch-off time and confirmations time by an operator of signaling every work [1].

On today of the HMI subsystems two channels of human perception are used - is sight and ear. Depending on the features of technological object and work regime for bringing of operator attention various facilities can be used: conclusion of report on the computer screen or operator panel, discoloration elements of mnemonic scheme, switching of signalization lamps or gleam lighthouses lights, and also generation of sound signal on a computer or by the special devices. The control systems by the geographically distributed objects can inform operators by means of dispatch of short messages on GSM- or DECT-telephones.

For the decision of the second task - initial information of operator - the channel of visual perception is mainly used, on which is by estimations of different researchers from 80 to 90 percents of all information perceived by a human. Information of operator by reproduction of vocal reports in general case is less effective due to the low "carrying capacity" of perception auditory channel.

In the case of absence in to ACS of developed to the HMI functions of signaling subsystem usually decide by the separate devices of notification: lamps, bells, sirens, posts of signaling, etc. Ukrainian industry a lot of years produces similar devices. They differ by high reliability, wide range of working terms, stability to external influences, but the limited functionality and archaic enough design is had.

Western producers besides similar emergencies devices often apply the devices of the generalized state signaling of production lines and machines. They allow to the operator from afar at a glance to define general status of every functionally selected knot of management object [1].

These devices have module construction and are executed as a typesetting "tower" or "column". The elements of alarm column provide the permanent or blinking light signaling of a different color, sound signaling encoded by tone and form of signal, and the SMS-messages even can independently order to the cellular telephones of the GSM standard.

The spectrum of signaling devices isn't limited to the gleam lighthouses, sirens and alarm columns. There are more difficult technical decisions, such, for example, as vehicle vocal module for the SCADA-systems, which is intended for reproduction to the operator of the in real time synthesized vocal messages about the state of management object.

In the SCADA-system creation of text message is the most traditional method of presentation of some event. The message, as a rule, isn't the unique method of operator information about an event, sound signals can be generated additionally, the colors of objects mnemonic schemes, statuses of the generalized state indicators of technological knots, can change, to be commuted modes of alarm columns, etc.

In general case the message about an event is the text string formed from a few semantic blocks. The amount of blocks, their maintenance and form of their presentation, is determined by the HMI designer. To the most standard blocks behave date, time, status, message text. Additionally can be specified source, management contour, technology area, values of one or a few parameters.

All modern SCADA-systems have powerful facilities of messages archiving, and also flexible possibilities of viewing and analysis of archives statistics. A technologist at the desire can not only analysis history of technological process and operator actions but also estimate frequency of appearance of every event either mean time to the operator reaction on different messages or to export information interesting him in a file for subsequent treatment in the external appendix.

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