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ЕЛЕКТРОТЕХНИКА, ЕЛЕКТРОНИКА И АВТОМАТИЗАЦИЯ

Section 2

ELECTRICAL ENGINEERING, ELECTRONICS AND AUTOMATION

APPROACHES FOR SECURING ELECTRONIC AUTOMATION SYSTEMS

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Abstract

This article discusses the basics associated with securing an automatic electronic system, both software and hardware. Ensuring generally can be classified as such purely control character reference whether a system is functioning properly, but also to reserve its functions. Object of the examination are also areas which are useful in such devices, the need for this type of modules and basic types of structures.

Keywords: Automatic electronic system; securing and monitoring; redundancy; electronic automation; programmatic article.

INTRODUCTION

Practice of areas where the use of automatic systems affects every area of human development. Gradually increase the impact of technology in everyday life dictated by technological development, as explain in [1], became unthinkable life without the use of electronic systems. This of course poses its own risks. Accordingly, by application of a specific system and follow the requirements for reliable operation, discussed in [2],[3]. On the basis of this can be made a brief classification of these electronic devices according to type of responsibility they take, shown in [4].

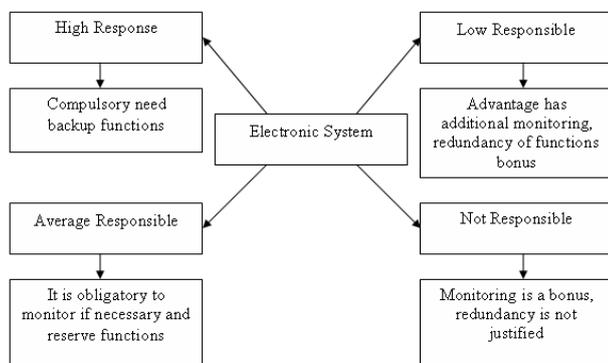


Fig. 1. Classification of electronic systems based on responsibility

Any electronic system has particular application and relevant software and hardware that meet the projected job

from the manufacturer. It has a mean relatively, more complex electronic circuits, for reference in [5]. This means that the system knows or process parameters are investigated. It is in a configuration appropriate system to be able to work in several areas of application are so-called development systems for them, are characterized by a set of hardware peripherals that can be used to collect information from several different types of feeds or sensors, but have firmly embedded algorithm work by the manufacturer. Programming is done by the user which defines the assignment. They are also hybrid systems proposed in [6] in which the assignment is set by the manufacturer, the user is able to process parameters tweaked a bit. The electronic system to ensure the work itself monitored and based on the algorithm decides and control. The idea of the reserved monitoring and control, described in [7], is that simultaneously with the main electronic system works and a second one which was a copy of the first or is in different shades of interconnection as needed. Thus it is ensured the primary system.

TYPES OF SECURE

The following are possible situations ensuring:

- Under the monitoring means measuring the operation of the basic - system of second additional electronics that only transmits information to the operator whether the main works and takes decisions.
- Under the monitoring and control means that in addition to providing - information to the operator whether the

main work and correct decisions redundant system can take control of the main, reactions and adjusting according to the assignment.

- Hybrid version. - In part it functions subject only to monitoring and other measuring and control. This applies in cases where the job responsibilities perform mixed i.e. some functions is critical whether you meet while others not so fatal to any break. Many types of systems are usually in the area of a not responsible.

As revealed by what scope is wide and allows separation of any of these cases yet to in case. Booking is impossible without monitoring while the opposite is possible. The reason is that there is no way to take control of the process when the current parameters are unknown. Two main lines can be classified relationship between the two systems - working algorithm and hardware to secure system, as in [8].

In many responsibility application there may be complex combinations of these in cases when relying on more than one back-up system, for reference [9].

Practical construction of a redundant system is designing the electronic system performs the job of the primary system. This design can be alleviated to the complexity of the main system depending on the nuances according to the required degree of redundancy, shown in [10].

BASIC TYPES OF STRUCTURES TO MONITORING AN ELECTRONIC SYSTEM

The following figures show various options for securing an electronic system through another. On the basis of these embodiments can be constructed and hybrid depending on the specific requirements, but the meaning is the same.

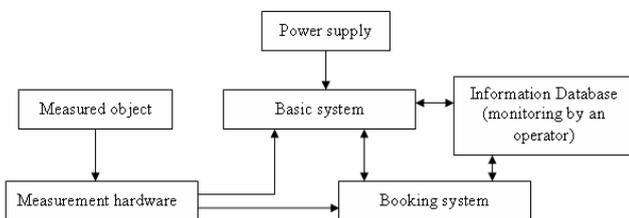


Fig. 2. Block diagram for reservation system type 1

Summary components given to the block diagram have the following meaning:

- The test subject is a parameter (particular quantity - electric or non-electric), a process or set of processes living organism;
- For major system bear in mind microcontroller, attached peripherals and electronic items to cover the needs of the job;
- For redundant system has in mind an electronic circuit (not necessarily contain controller), covering the requirements for the desired degree or parameter secure;
- The control hardware includes all sensors, actuators in the event that there are two-way channel between the subject and the hardware and operating circuits for collecting information;
- Information database includes specific software to work with the assignment. Setting the parameters or just memory, which collects data for statistical evaluation of measurement;

- The power supply provides all the necessary power voltages to operate the specific formulation according to the assignment;

In essence communication between the blocks can be divided according to the type of interface or under the type of connection used.

Accordingly, based on the type interface such use internal inter-chipset interface for short distances within a board SPI, I2C, UART and others, or using remote communication interface RS485, one wire, 4-20mA current loop, Ethernet and others, connection between modules. The separation according to the type of connection should be wired and wireless.

Under a system of "type 1" measurement hardware is common. The main system and reserved use it at the same time each takes from it what they need. Simultaneously, the booking system has access to the operating system registers the main purpose is to make a comparison between the data received from the measurement hardware and processing the information. If the back-up system does not contain in it a microcontroller, then signals are observed in a control point. Based on this can be found by booking system exactly which block problem. Monitoring software receives data from both units, regulations and displays the type of error. Power is generally supplied as the main system of booking. In case of failure in electrical circuits, system diagnostics into account the absence of any information.

The design of the simplest system of type 1 requires:

- Access to electrical signals transmitted by the measurement hardware and basic system;
- The complete wiring diagram of the Basic system;
- Information for specific use sensors and mode of operation;
- To have the software stored in the main system controller;
- Access to the source code of computer software (database);
- Clarity on the parameters to be monitored;

On the basis of all this has drawn algorithm work.

Advantages of such systems:

- 1) Cheap circuit topology enabling to note exactly where the problem (in which one block);
- 2) Good security;
- 3) Is realized with a minimum number of external components;

Disadvantages:

- 1) Use common measurement hardware;
- 2) The power source is common;
- 3) The pooling of the "Ground";
- 4) The information database is common;
- 5) A source code for the main system processor;
- 6) In the absence of documentation from the main system it is possible the realization of this type of structure;

Last most significant disadvantage starts from the position that the system is relatively complex and contains at least one microcontroller, as explain in [10]. Since it is possible with simple systems with pure discreet performance, including standard analog and digital signals do not require special documentation, but only given access control points.

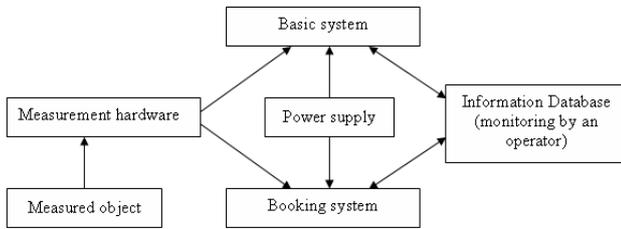


Fig. 3. Block diagram for reservation system type 2

Under a system of "type 2" measurement hardware is also common, but the booking system works autonomously. No access to processor memory from the main system power is obtained from the individual power circuits, although they use a common source (e.g. batteries). Information database is common and this suggests the need for knowledge of basic software system.

The design of a system of type 2 requires:

- Access to electrical signals transmitted by the measuring equipment and power source;
- Knowledge of the process that will be monitored;
- Information for specific use sensors and mode of operation;
- Access to the source code of computer software (database);
- Clarity on the parameters to be monitored;

Advantages of such systems:

- 1) Relatively inexpensive circuitry decision;
- 2) Good security;
- 3) The supply power circuits are separate;

Disadvantages:

- 1) Use common measurement hardware;
- 2) The power source is common;
- 3) The pooling of the "Ground";
- 4) The information database is common;
- 5) In the absence of documentation from the main system is laborious decipher the logic of work;

Lack of documentation in the design is the most important issue here as to decipher and use a decision algorithm of work may require long operating cycle (weeks, months) depending on the degree of complexity.

Some manufacturers deliberately remove the markings of electronic components or pasted scheme against disassembly. So can practically impossible hardware decoding.

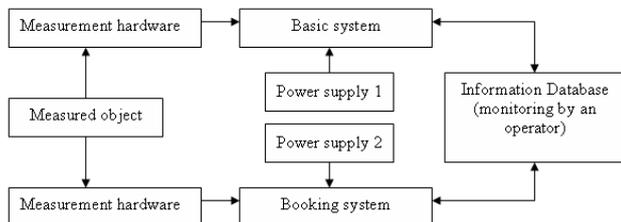


Fig. 4. Block diagram for reservation system type 3

System "type 3" is a characteristic that has two separate measuring hardware one for main and reserve system. When booking the full set of basic system then these two blocks are identical. Each system uses separate power supplies and no galvanic connection between them. Information database is common, but when it happens to communication in various protocols, including wireless between the two systems need to combine "the masses." This is the case for example in which one system

communicates with a remote database via Ethernet protocol or wireless radio channel.

The design of a system of "type 3" requires:

- Access to research the subject;
- Knowledge of the process that will be monitored - the physical meaning of its parameters;
- Access to the source code of computer software (database);
- Assignment on the parameters to be monitored;

Advantages of such systems:

- 1) Relatively inexpensive circuitry decision;
- 2) A high level of security;
- 3) Power supplies are separate;
- 4) Each system uses its own measurement hardware;

Disadvantages:

- 1) Expensive price realization as duplicate measurement hardware;
- 2) The information database is common;
- 3) Requires access to the source code of the database;
- 4) The required element base is bigger here and times for design and craftsmanship;

CONSTRUCTION FOR MONITORING AND RESERVE AN ELECTRONICS SYSTEMS

In three cases described in the preceding paragraph is necessary to know the source code of the database (computer software) in the event that this can not happen, it is the decision making of their own environment in which to observe failures. In general, each of these projects can not be implemented in the absence of documentation from the manufacturer. So the producer himself or realize it or persons authorized by him having a license. Here accordingly has in mind a complex and responsible system and not some "garage" devices.

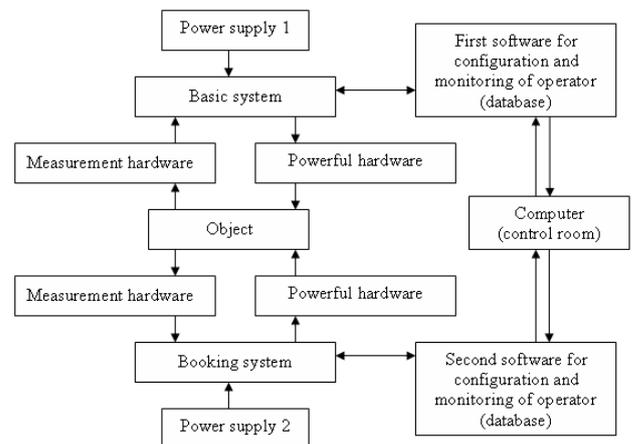


Fig. 5. Block diagram for reservation system type 4

In systems of type 4 real reservations system and core are the same i.e. interchangeable. One has nothing to do with the other, although can be collected in a single case or facility.

The design of the most complex system of type 4 requires:

- Very good knowledge of the subject matter of the assignment which will be prepared reservation or control;
- Clarity on the physical origin of the quantities to be reported;

- Introduction to the assignment of the primary system;

Advantages of such systems:

- 1) Reserve can take any function of the primary system or vice versa;
- 2) Maximum level of security;
- 3) Software for setting and monitoring are totally individual and can be installed as a single or separate computer;
- 4) You do not necessarily to have the technical documentation for the main system, it is important assignment;
- 5) The power sources are separate and no galvanic connection;
- 6) Not required unifying "Ground" for the two systems;

Disadvantages:

- 1) Everything must be duplicated (software and hardware);
- 2) Difficult to prepare practical and unjustified except for very special applications in the military industry;
- 3) Very high price for realization;

ADDITIONAL CONSTRUCTIVE APPROACHES AND FEATURES

In some many cases is used so-called output of the system in emergency mode. When it is permissible to break the current job to avoid unintended consequences and is not justified reservations with activation of a second redundancy, for reference see [12]. It is cheaper circuit topology so-called insurance system feedback. Here the main system except that monitors and ensures the management of a specific site and it monitors critical parameters of the job, if it switches detect conflict management in emergency mode.

This applies mostly by economic considerations for applications in charge average risk. Summary idea is shown in the following figure.

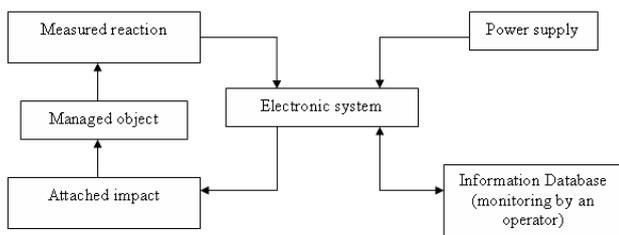


Fig. 6. Block diagram for reservation system with feedback

Practical systems provide redundancy not be differentiated as separate systems and separate subsystems embedded in the base system as the model of "Type 1", "Type 2" and "Type 3". When talking about applications in mass sphere they all had some kind of reservation, as in the most responsible is duplicated except sensors and controllers. All of this is separated into one common system performs a specific function. They do not speak of them as something separate, but rather the advantage is given guarantees for high reliability by a system. Practical manufacturer to ensure a responsible use of its electronic product it must be the maximum possible as adverse situations accordingly prepare your system for them. All Signals between modules and software is common, as it provided emergency situations.

When talking about separate systems, invested in to work with another system as per the "Type 3", they are aimed at them some versatility. They could be implemented

as a single system to perform a task only the specifics of the job type monitoring and control other system in combinations with the wiring diagram gives reason this system is interpreted as executing such monitoring or redundant. In practice such a system has everything you need to work as principal.

The speed of the electronic systems is crucial for their consumption. As a massive modern ICs are made of CMOS structures, shown in [13]. In these loops is decisive on the performance of the chip. In charge of the capacitor current is a maximum. At higher frequency operation overcharging these capacities is more common here and the average consumption increases. For basic system operating frequency is determined by the assignment. Reservation system operating frequency can be equal to or lower than that of the main system depending on to what extent is reserved.

CONCLUSION

The article reviewed the basics were associated with securing an automatic electronic system. Seen are also the areas in which these devices are used, the need for this type of modules and basic types of structures. In general, the theme is very extensive and affects each direction in which develops modern electronics and automation.

As main benefits of the article can be identified: Summarized are the main principles and options for design, analysis is made of the degrees of responsibility according to the complexity of the electronic system described are some peculiarities in the design of such systems.

Disadvantages: In view of the large volume of information are considered too general things without specific examples are not affected issues related circuitry and software.

REFERENCES

- [1] Karl L. Gunter, Victor H. Shear "Systems and methods for secure transaction management and electronic rights protection" of the IEEE, vol. 120, No. 15.
- [2] Jim R. Oliver "Journal of management information systems" Vol. 13, No. 3, Information Technology and Its Organizational Impact (Winter, 1996/1997), pp. 83-112.
- [3] Jill K. "A zigbee-based home automation system" IEEE. Volume: 55, Issue: 2.
- [4] Bolton William, Electronic "Control systems in mechanical and electrical engineering" Mechatronics 2007.
- [5] P. Bergstrom, K. Driscoll, and J. Kimball "Making home automation communications" IEEE Computer, vol. 34, 2001, no.10, pp. 50 – 56.
- [6] Malik Randhir S, Apparatus, system, and method for event, time, and failure state recording mechanism in a power supply, Apr 2, 2011.
- [7] Jen-Hao Teng; Chin-Yuan Tseng; Yu-Hung Chen "Integration of networked embedded systems into power equipment remote control and monitoring" IEEE, 2004.
- [8] Frazer Leslie PEREIRA "System and method of fault detection" Aviation Systems Inc., Aug 27, 2015.
- [9] Kathleen R. Wooten, Thomas F. Doyle, Marie Bjerede, Marshall Hurst "Method and apparatus for the remote monitoring and configuration of electronic control systems" Jul 4, 2000.
- [10] Robert P. "Electronic Security Systems" 2008.
- [11] Lukas D. Kuhn, Johan de Kleer "Methods and systems for fault diagnosis in observation rich systems" Palo Alto Research Center Incorporated, Sep 29, 2010.
- [12] Gareth P. "Analog devices for microprocessors" 1981.
- [13] Manjul Bhushman, Mark B. Ketchen, "Microelectronic test structures for CMOS technology and products" 2011.