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SYSTEM OF HETEROGENEOUS DATA TRANSMISSION ON THE BASIS OF A SELF-REGULATION NETWORK WITH AN OPTION OF RETRANSMISSION

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The article discusses structural features of wireless data transmission technologies. Based on client-server architecture, a data transmission algorithm has been developed. This algorithm includes the possibility to retransmit with automatic search for the optimal path. A system of heterogeneous data transmission is proposed, which ensures high efficiency of remote data collection and transmission under the conditions of intensive interference. The data transmission system provides automatic selection of the optimal data transmission path.

***Keywords*:** wireless technology, data transmission, heterogeneity, retransmission.

Introduction

Nowadays, wireless data transmission technologies are widespread and today they are experiencing a kind of boom due to the undeniable advantages that they have. At present, for developers of wireless communication technologies, designing and producing a wireless data transmission system suitable for retransmitting and optimizing the data transmission path is an important task, both in terms of providing high technical characteristics and from the standpoint of economic expediency.

The work attempts to create an automated system of heterogeneous data transmission based on an algorithm of a self-regulation network with an option of retransmission, which is competitive at the modern market of wireless technologies.

1. The structure of the developed system and algorithm of its operation

The proposed wireless data transmission system consists of three main elements: 1 — a data collection unit, 2 — a device providing wireless radio data transmission, 3 — a data collection point device (Fig. 1).

In order to ensure the practicality and reliability of the developed algorithm of the self-regulation network with an option of retransmission, the created network was implemented as a wireless mesh topology — a wireless device network built on the mesh principle, in which the devices are connected to each other and are able to play the role of a switch for other devices [1]. That makes possible to use the proposed network under hostile environment conditions or in places where the use of wired technology is very difficult.

From the studied analogs belonging to the WPAN class (Wireless Personal Area Networks), Wireless HART network technology is the closest to the concept of the data transmission algorithm of the developed system. The latter maintains equipment from different manufacturers and uses self-organizing and self-healing mesh architecture.

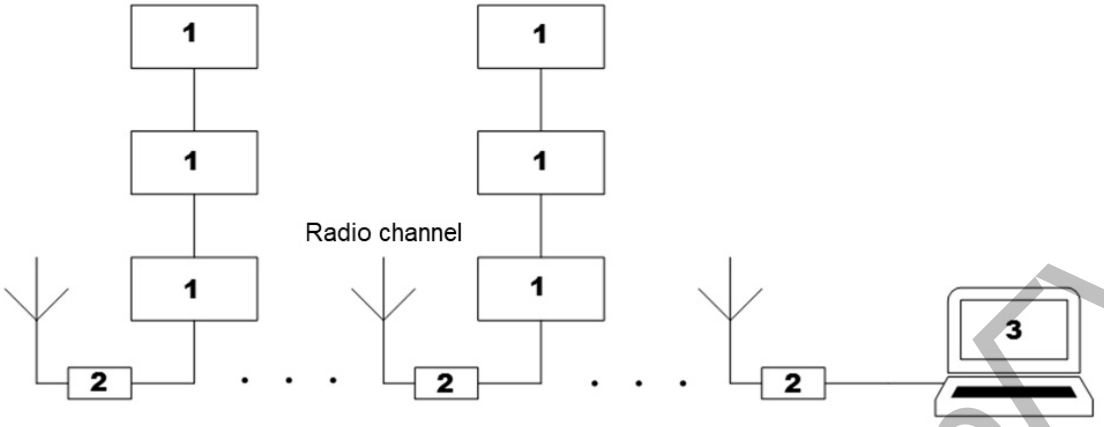

Fig.1. The circuit of the developed system.

The network operation algorithm corresponds to the scheme shown in Figure 2. Here objects 1 ... 4 are wireless data transmission devices. Retransmission assumes data transmission via intermediate devices [2]. In the case when device 1 cannot directly communicate with device 4, their communication will be achieved sequentially through intermediary devices (for example, 2 and 3).

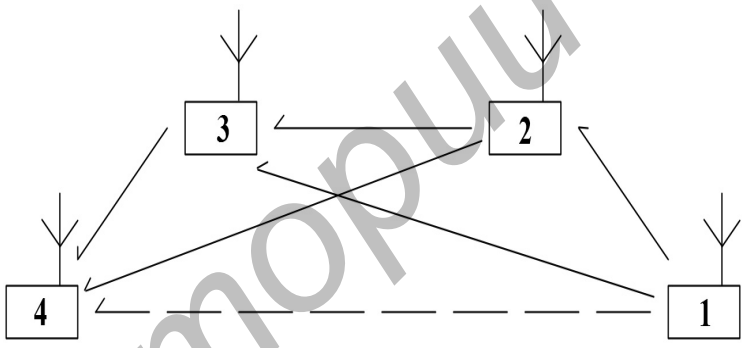

Fig.2. Retransmission circuit.

The Elsima controller [3], a functional complete product designed for operation in small automation systems with up to 100 I /O signals, serves as the data collection point of the system. If it is necessary to increase the number of signals, the controller makes it possible to connect remote I/O modules of Elsima and similar to it.

In practice, the considered controller is mainly used in small systems of automatic and automated control of technological processes in such areas as control of climatic equipment, control of small machines and mechanisms, automation of boiler houses, work in systems like “Smart Home” and other facilities. The operation algorithm of the controller is determined by the control program developed by the user in accordance with the requirements for the control system created using the controller.

The system uses such capabilities of the programmable controller as operation with RS-485 interface, Ethernet (local area network) and GSM/GPRS modem. The wireless device interrogator is connected to the controller via RS-485 interface. Then the collected data is transmitted to the operator in one of the ways: using either Ethernet or the built-in GSM/GPRS modem. In case of failure of one of the communication methods, it is possible to use another one.

The developed secondary algorithms for the data collection point significantly expand the functionality of the system. The first algorithm is the initialization of the GPRS module, which is a backup mode for transmitting the collected data and will work in case of a local network failure.

The second algorithm is designed for notification of a communication break in the system at the request of the operator: the operator sends an SMS message with a request about the state of the system and receives an SMS response message with information. This makes for remote monitoring of the system.

To implement the data transmission algorithm, a model of a wireless device was assembled, using which it is possible to gradually develop, test and modify the algorithm. The model includes the following main components: microcontroller, radio module, display module, expansion module.

The system was described using the automaton state. At the stage of data generation, an algorithm for determining the optimal path, based on the calculation of the path rating, comes into operation. In this case, the path optimality is determined by the highest value of the path rating. When calculating the rating, the level of communication between devices and the number of retransmission units are taken into account.

In order to systematize the information and for convenience in operation with the system, a table of commands is created. In the table, the following data is shown: codes of commands executed by the system, their description, address where the command is sent, who sent it, as well as a description of the data that appear when the command is executed. This ensures the completeness and availability of information.

To control the transmitted data, a cyclic redundancy check code (CRC) is used - a checksum algorithm used to check data integrity. CRC is a practical application of error control coding, based on certain mathematical properties of a cyclic code.

Based on the used algorithm schemes, a software code for data transmission was developed, consisting of the following main parts: CRC implementation, data sending by the device, using the Send forwarding method, receiving data by corresponding devices, and an optimal path search algorithm. It should be noted that this system involves two algorithms for receiving data: one is responsible for receiving data by the interrogator device, and the other algorithm is for receiving data by the slave device. A distinctive feature of the latter is the state of execution of commands by the slave in accordance with the table of commands.

2. Results and discussion

The proposed data transfer design is highly competitive with current analogues, both in technical and operational characteristics, as well as in device functionality. At the same time, competitive advantages are offered due to the heterogeneity of the system, the possibility of retransmitting data transmission and self-regulation capability of the network. Heterogeneity provides the possibility of implementing both wireless and wired data transmission, depending on the influencing factors. A distinctive feature of the described data transmission system is the possibility to automatically select the optimal data transmission path.

The optimal operation of the developed system of heterogeneous data transmission is achieved due to the capability of the network to self-regulation, retransmission, as well as the expansion of the functionality of the system under study on the basis of the developed secondary algorithms using the Elsima controller.

The research results indicate that on the basis of the developed software solutions, it is possible to create various analogues of a system with different functionality, as well as to integrate into another product for which such a technical solution is available.

Conclusion

A system of heterogeneous data transmission based at a self-regulation network with an option of retransmission has been developed. The possibility of remote monitoring of the system, as well as the possibility of creating its counterparts with different functionality. The system has a high degree of reliability and efficiency, makes for its competitiveness in the market of wireless technologies.

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3 *Programmable logic controller Elsima.* Manual. ZAO EleSi, 2017, pp. 138-146, pp. 78-102. [in Russian]

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