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Model conception and functional testing of Internet based system for measurement and control

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Abstract

This paper presents the model conception of Internet based system for measurement and control, which is grounded on the reference model OSI (Open System Interconnection). The model defines a parametric method for functional testing.

Keywords: Internet based system, OSI model.

Model i test funkcjonalny internetowego systemu pomiarowo-sterującego

Streszczenie

W artykule przedstawiono koncepcję modelu sytemu pomiarowo-sterującego opartego na sieci internetowej, wykorzystującego model OSI, opisujący strukturę komunikacji sieciowej. Model ten definiuje metodę parametryczną testowania funkcjonalnego.

Słowa kluczowe: Internetowy system sterowania, model OSI.

1. Introduction

Some measurement and control methods for different systems require different reference signals [1, 2]. This problem can be successfully solved by means of functional generators. Such generators produce signals which are described by calibrated parameters.

The remote measurement and control require communication area to be build. An opportunity is the using of computer networks. This enables the measurement and control realization without building new communication networks.

The purpose of this paper is to define the model conception of Internet based system for measurement and control. The system performs some tests which allow the quality of the system to be checked.

2. Model conception of Internet based system for measurement and control

The model conception of Internet based system for measurement and control, which is grounded on the reference OSI model is shown on Fig. 1 [3, 4].

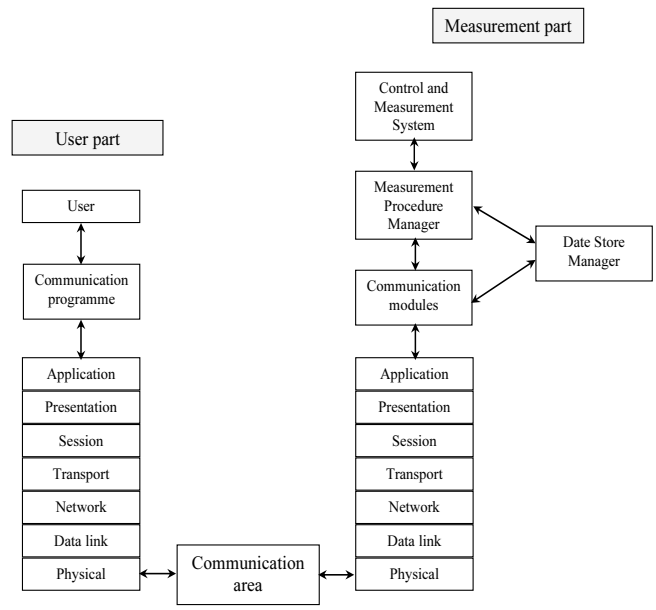

Fig. 1. Model conception of Internet based system for measurement and control using the reference OSI model
Rys. 1. Koncepcja modelu internetowego systemu do pomiarów i sterowania, wykorzystującego model odniesienia OSI

The model includes: an user part, a measurement part, and a communication area (local area network or Internet). The user part includes the user communication program and seven layers of OSI model. The measurement part includes: the control and measurement system, the measurement procedure manager, the data store manager, communication modules and seven layers of OSI model. The algorithm describing processes in the model of Internet based system for measurement and control, grounded on the reference OSI model, is shown on Fig. 2. The algorithm starts with user connection to the Internet server by communication program. After legally registration the user chooses the standard signal, sets signal parameters, chooses the measurement mode and channel. The next step is the data transmission to the network. After data receiving the server starts the process of measurement and control. The software program performs data processing of the selected parameters and transmits them back to the user. Then the received data are displayed. The algorithm finishes with two options. The first option is the program return to the main menu, and start of a new measurement. The second option is ending of the program. The data transmission between user part and measurement part is based on the reference OSI model.

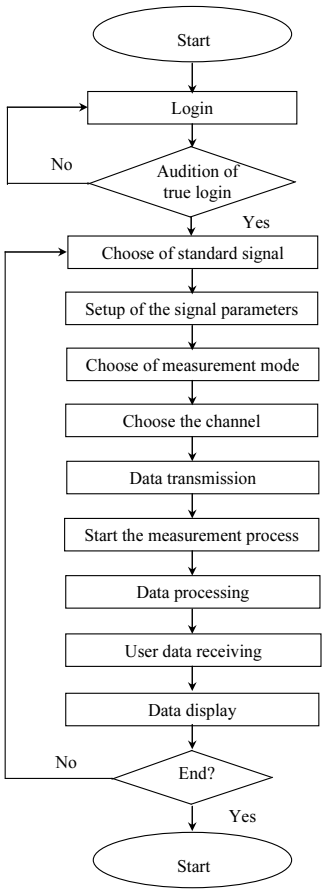

Fig. 2. The algorithm implemented for processes in the Internet based system model for measurement and control, using the reference OSI model
Rys. 2. Struktura algorytmu zaimplementowanego w modelu internetowego systemu do pomiarów i sterowania

3. Parametric method for functional testing of the system

The model conception of Internet based system for measurement and control, which is grounded on the reference OSI model allows five group of parameters to be defined:

- User – defines the user interface parameters;
- Net - defines the network parameters;
- Prog - defines the program part parameters;
- Dev - defines the measurement system part parameters;
- Conn - defines the association parameters between the program and measuring system part.

Therefore, the parametric method for functional testing can be described by the following equation [5]:

$$IVIQM = IVIQM_{\text{User}} + IVIQM_{\text{Net}} + \\ + IVIQM_{\text{Prog}} + IVIQM_{\text{Dev}} + IVIQM_{\text{Conn}}, \quad (1)$$

where $\text{IVIQM}_{\text{User}}$, $\text{IVIQM}_{\text{Net}}$, $\text{IVIQM}_{\text{Prog}}$, $\text{IVIQM}_{\text{Dev}}$, $\text{IVIQM}_{\text{Conn}}$ are the particular matrices.

The matrix IVIQM defines the realization quality of Internet based system for measurement and control. The matrices $\text{IVIQM}_{\text{User}}$, $\text{IVIQM}_{\text{Net}}$, $\text{IVIQM}_{\text{Prog}}$, $\text{IVIQM}_{\text{Dev}}$, $\text{IVIQM}_{\text{Conn}}$ define the realization quality of different groups (user interface, network, program part, measurement system part and association parameters between program and measure system parts). Every one of the matrix can be defined as product of parameters element matrix and weight element matrix [5]:

$$\text{IVIQM} = \sum_{i,j}(\mathbf{u}_{i,j}\mathbf{w}_{u_{i,j}}) + \sum_{i,j}(\mathbf{n}_{i,j}\mathbf{w}_{n_{i,j}}) + \\ + \sum_{i,j}(\mathbf{p}_{i,j}\mathbf{w}_{p_{i,j}}) + \sum_{i,j}(\mathbf{d}_{i,j}\mathbf{w}_{d_{i,j}}) + \sum_{i,j}(\mathbf{c}_{i,j}\mathbf{w}_{c_{i,j}}), \quad (2)$$

where

- **u** is the matrix of parameters related to the user interface, and $\mathbf{w}_\mathbf{u}$ is its weight matrix,
- **n** is the matrix of parameters related to the network, and $\mathbf{w}_\mathbf{n}$ is its weight matrix,
- **p** is the matrix of parameters related to the program part, and $\mathbf{w}_\mathbf{p}$ is its weight matrix,
- **d** is the matrix of parameters related to the measuring system, and $\mathbf{w}_\mathbf{d}$ is its weight matrix,
- **c** is the matrix of parameters related to the associations between the program and measuring system part, and $\mathbf{w}_\mathbf{c}$ is its weight matrix.

All elements of matrices **u**, **n**, **p**, **d** and **c** are technical parameters of particular function or combination of functions. Sizes of matrices are defined by number of technical parameters. The matrix **u** can be presented in the form [5]:

$$\mathbf{u} = \begin{vmatrix} u_{1,1} & u_{1,2} & \cdots & u_{1,j} \\ u_{2,1} & u_{2,2} & \cdots & u_{2,j} \\ \vdots & \vdots & \vdots & \vdots \\ u_{i,1} & u_{i,2} & \cdots & u_{i,j} \end{vmatrix} \quad (3)$$

The user interface parameters include: kind of communication program, setup of regulation, selection of measurement parameters, displaying, storing, and data processing. Parameter values are defined by the following equation [5]:

$$u_{i,j} = \begin{cases} \dfrac{N_\text{b}}{N_\text{t}}, & N_\text{t} \neq 0 \\ 0, & N_\text{t} = 0 \end{cases} \quad (4)$$

where

- N_b is the number of incorrect behaviors;
- N_t is the number of carried out tests.

Analogously to matrix **u** matrices **n**, **p**, **d** and **c** can be built up, corresponding to the user interface, the network, the program part, the measurement system part and the association parameters between program and measure system parts, respectively.

The weight matrices $\mathbf{w}_\mathbf{u}$, $\mathbf{w}_\mathbf{n}$, $\mathbf{w}_\mathbf{p}$, $\mathbf{w}_\mathbf{d}$ and $\mathbf{w}_\mathbf{c}$ are built in the manner analogous to the matrices **u**, **n**, **p**, **d** and **c**. It means that each weight corresponds to specified parameters or a combination of parameters. The weight matrices can be built up according to the measurement scenario or to the model base on the data flow and data processing scheme in Internet based system for measurement and control.

Hence the architecture of the weight matrix $\mathbf{w}_\mathbf{u}$ is [5]:

$$\mathbf{w}_u = \begin{vmatrix} w_{u1,1} & w_{u1,2} & \cdots & w_{u1,j} \\ w_{u2,1} & w_{u2,2} & \cdots & w_{u2,j} \\ \vdots & \vdots & \vdots & \vdots \\ w_{ui,1} & w_{ui,2} & \cdots & w_{ui,j} \end{vmatrix} \quad (4)$$

The weight value is defined by the equation [5]:

$$w_{u\,i,j} = P(A \cap B) = P(A) * P(A/B), \qquad (5)$$

where

- P(A) is the probability of the event A occurance,
- P(A/B) is the conditional probability of the event B occurance, if event A already has occured.

After the definition of the elements of matrices, the values of matrix IVIQM are calculated from the equation (1). If the value matrix IVIQM tends to 0, the Internet based system for measurement and control works with good quality. If the value IVIQM tends to 1, the system works with poor quality, and have to be improved.

4. Conclusion

In the paper we have defined the model conception of the Internet based system for measurement and control, which is grounded on the reference OSI model. The model defines the parametric method for functional testing. The quality of the system can be assessed and eventually improved.

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