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NEW METHOD FOR SIMULATION OF SEQUENTIAL DESCRIPTION OF COMPUTERIZED SYSTEM

The paper suggests the method for simulation of sequential description of computerized systems of diagnosing and controlling over parameters, intended for testing the workability of the sequential model on the basis of original approach of its formalization.

Keywords: *sequence, simulation, sequential description, computerized system.*

1. Task setting

It is commonly asserted that during the designing of the logical blocks (automates) of technical systems, the usage of sequential description [1] is widely spread. This description allows to formalize all the correspondings between the combinations of input and output signals, synthesize the control structures, optimize the system structure, automatically synthesize the optimal as for the number of elements, the electronic scheme of controlling automate of the system. The existing theoretical base of the synthesis of sequential automates had been thoroughly approbated and has good records during the synthesis of the controlling automate in the kind of electronic scheme.

During the designing of technical systems it is expedient to simulate the structural schemes of these systems is such software packages as Matlab, MicroCAP etc, with an aim of determining the systems' working ability and correspondence of the systems' operation results to the set tasks. Such software package does not exist for sequential description of the technical systems. Let's eliminate this problem.

The usage of the great number of symbols and equations during the sequential synthesis increases the probability of mistakes, which will be identified only during the development of the schema of the synthesized device. Economically it is more efficient to conduct test of the sequential model, simulating it on computer.

Technically the realization of the logical (control) block on computer – this is the programming of the branching out of the "if...then..." type. Under condition of great number of input and output signals, the programming of all possible variants of their combination may be extremely long. Consequently, the usage of the minimized sequential description appears to be expedient.

Thus, it is necessary to solve the following task: to develop the simulation method for logical block of the computerized system on the basis of its sequential description – develop the appropriate mathematical, algorithmic and software background. Software itself must synthesize the program code in accordance with the sequential model.

2. Ideas for method realization

Synthesis of digital scheme with the usage of sequences has the following stages [3]:

- determination of input and output signals depending on the operation conditions of scheme;
- determination of output functions and functions of exciting of memory cells;
- coding of inputs, outputs and inner states, considering the conditions of the system operation;
- creation of the sequential model of system's operation with its further minimization, by removing the equivalent states and transfers;
- choosing of elements with further realization of structural diagram of the system.

All the above operations are strictly formalized and algorithmized.

We suggest the following analogue of formalization and algorithmization of these operations during the simulation of the sequential description of the computerized system logical block of the specific computer program:

- entering on the program names and characteristics (in what fables, where the results of signals reading through the computer ports are kept – this may be tables on the other computer, accessible

via net) of input and output signals;

- synthesis of program code of the generation subprogram in the cycle of state variables T_i ($i = 1 \dots, N$);
- adjustment of processing mechanism and saving the processing results to the appropriate data base tables;
- adjustment of the processing results visualization instrument kit in the kind which is comfortable for the user;
- ensuring the presenting of the results in the kind which is suitable for transferring to the other program packages — Matlab, Maple, Mathcad, MS Excel etc;
- automatic synthesis of program code for data processing, synthesis of tables and data base forms in MS Access or MS Excel, which automate all the previous stages as a whole;
- testing of the synthesized logical part of the system on examples; its improvement (the repetition and re-adjustment of the software on separate stages is possible).

3. Operation and interface algorithms of computer program for simulation of sequential description of the logical part of the computerized system.

Let us consider in details the synthesis of the program code on each stage, as well as the way the program will “understand” the user’s directions – let’s describe the program interface.

The user on the first stage first fills in the form, indicating the number of input and output data and the names of their characteristics. On the basis of this information the program synthesizes the table in MS Access or MS Excel together with the corresponding form, the user has to enter the specific names for these signals and their characteristics to.

The obligatory characteristics are the path to the table which contains the signals observation results, names of its fields (numerical integer, numerical fractional, text etc). It is important that technically reading these data via internet does not create difficulties, that is, data processing may take place a long distance away from the measuring devices, which widens the abilities of the computer system as a whole.

On the second stage the user in the comfortable form adjusts the algorithm of automated padding of one more data base table with information on the system’s state based on the corresponding model.

On the third stage of the program the user specifies all the sets S_k ($k=1 \dots, K$) of combinations of input variables of state which are saved in the minimized sequential model of the system. As the result, the program forms the code of the “if... then...” type.

On the fourth stage it is strictly stated, in what tables (name, path, field) the values of output variables are saved, and the algorithm of their processing is assigned. For the processing programming it is possible to use the integral editor of mathematical expressions MS Access or the external calculation module in the MS Excel environment, which is more appropriate.

On the fifth stage we select the kinds of graphs, with the help of which the data processing results visualization will be done. This stage is expedient to realize in MS Excel.

Saving data processing results in MS Excel format automatically enables their further usage in all modern calculation packages Matlab, Maple, MathCAD etc., as all of them can directly apply to files MS Excel, which are commonly used as the standard of digital information storage.

Following the results of adjustment of all the forms, the program synthesizes the separate program package which performs all functions of logical part of computer system in MS Office environment. It would be expedient to test it on practical examples and improve it necessary. In such a case the program package must have the possibility of adjustments storage on each stage to ensure further editing of these adjustments.

The task is solved.

4. Example of application of the computer program for simulation of sequential description of logical part of computerized system.

Let us consider the operation of the developed software on the example. Fig.1 presents the form which helps enter the set of possible input and output signals of the system. Fig.2 and Fig.3 present forms, which help identify function of all the storing elements of the system and description of functions and parameters of each trigger of the system.

Введення вхідних даних

Введіть кількість, позначення та опис вхідних змінних:

Кількість:	Позначення:	Опис:
3	I	струм якоря двигуна ПС
	R	опір якоря двигуна ПС
	T	температура обмоток статора двигуна ПС

Введіть кількість, позначення та опис вихідних сигналів:

Кількість:	Позначення:	Опис:
2	Y1	Сигнал про вичерпання ресурсу колектора двигуна ПС
	Y2	Сигнал про вичерпання ресурсу обмоток статора двигуна ПС

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Fig.1 Introduction and description of the input and output signals of the system

Введення даних

Оберіть типи даних, що використовуватимуться:

☒ Порогові значення	☒ Генератори імпульсів
☒ Затримки часу	☒ Лічильники
☒ Сигнал пуску	☐ Режими роботи
☒ Онулення	☐ Інше

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Рис.2 Determination of functions of memory elements of the system

Рис.3 Determination of functions and parameters of each trigger of the system

Fig.4 presents the form, which help introduce the minimizing sequence system on the program.

Рис.4 Introduction of the minimizing sequence system

On the basis of previously entered data, all possible components of sequential model in the form of controlling elements “Flag” are generated on the form. Placing each such flag in the left and the right parts of the form, we choose correspondingly the inputs of the left and the right parts of the sequences. The low part of the window constantly presents the sequence, which is introduce, renewing after clicking any flag. Shall the error appear during the introduction of the sequence, button “edit” allows to enter the last sequence again.

Button “Not” performs the function of logical denying. Fig. 5 presents the results of simulation in the kind of the table and in the kind of triggers operations diagrams during the definite mode of schema operation. Each column of the table and diagram shows the state of the triggers which participate in the scheme operation at a definite moment of time. The results of simulation allow not only to estimate the result of scheme operation visually, bat to follow how the state of the system changes in time. This allows to check the scheme operation, as well as visually determine the stage the mistake was made on.

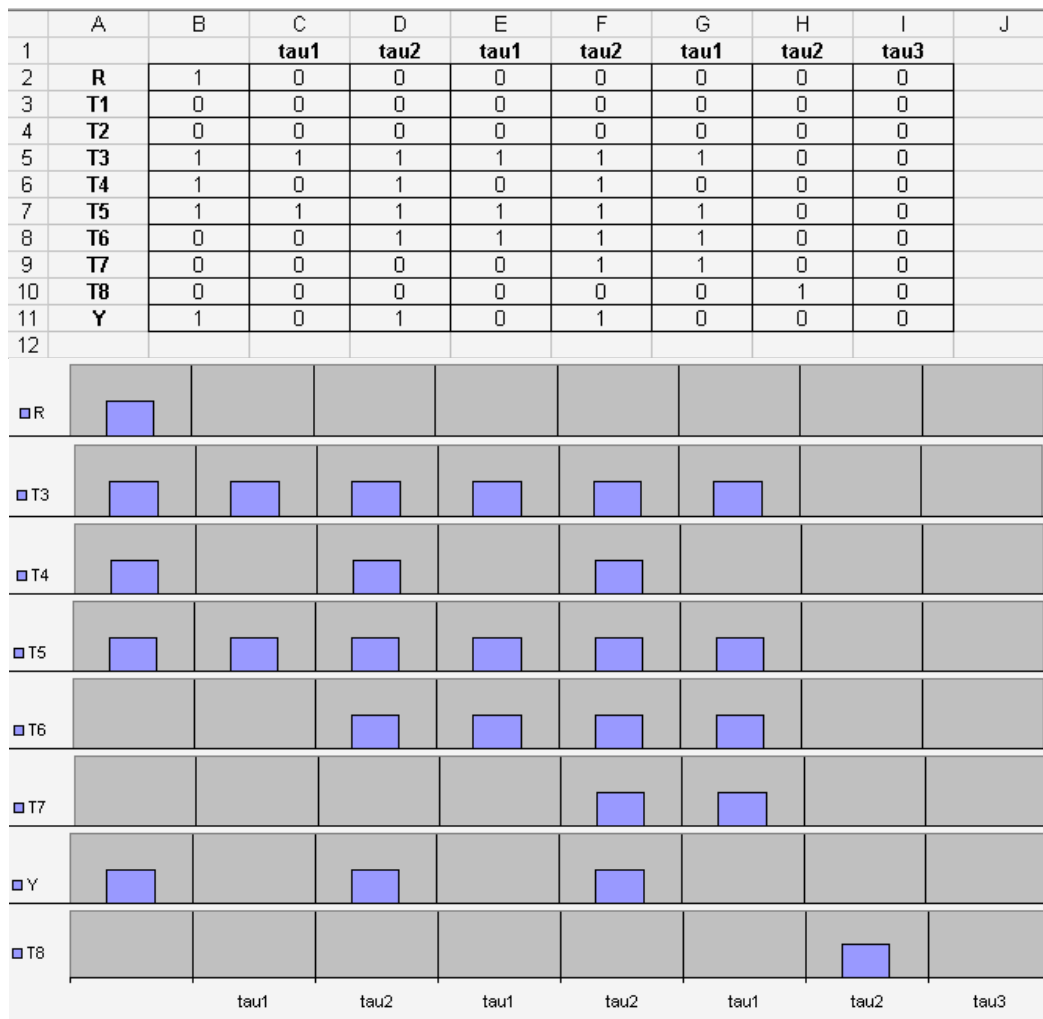


Рис.5 Simulation results

5. Conclusions

There had been suggested the method for simulation of sequential description of computerized systems for diagnosing and controlling of parameters, which allow to test the workability of the sequential model on the basis of original approach relative to its formalization.

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