



MATHEMATICAL MODEL OF CONSTRUCTION OF CASCADE LOGIC CIRCUITS AND SOFTWARE TOOLS FOR ITS RESEARCH

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ABSTRACT

Automatic control systems for the most complex objects and processes, intelligent software systems, computational planning systems, computer-aided design systems, expert systems - this is not a complete list of software and hardware systems, without which scientific and technological progress is unthinkable. Common to these and many other systems is that they contain or use a cascade logical construction scheme and control devices (counting and control, logical devices). The main feature that distinguishes these systems from others is that they include knowledge about the problem area in which they work, and about the possibilities of solving problems in it. This article discusses the mathematical model of building cascade logic circuits and software tools for its investigation.

INTRODUCTION

Computing systems have a special place in this list. The connection of the above systems with computer technology has two aspects: EHM is the main research tool, including modeling and complex systems, so they are an important research object, and the issues of organizing the control of the computing process are of special importance.

To describe, analyze and design these systems (devices), mathematical cybernetics apparatus is used to a large extent, the article mainly focuses on: formulas of logic algebra that implement logical functions on a given basis; schemes of functional elements that implement systems of logical functions on a given

basis; finite state machines that perform the transformation of input sequences into outputs; programs (algorithms) that calculate given formulas according to initial data, mathematical model of building cascade logic circuits and software tools for its research. Therefore, this mathematical apparatus is a powerful tool for modeling, in which not only the function of the object (process), but also its structure and scheme are accurately copied.

LITERATURE ANALYSIS AND METHODOLOGY

Note that the design of information processing devices and logical control systems (hardware and software) is currently characterized by the extensive use of microelectronics achievements. The



elementary basis of the synthesis is the integrated schemes of small, medium, large, very large and very large levels of integration (MIS, SIS, LSI, VLSI, UBIS). The ongoing trend in microelectronics to increase the level of integration of microcircuits has already led to the creation of very large integrated circuits.

A paradoxical situation arose. On the one hand, the rapid development of microelectronics, which is manifested in the continuous improvement and creation of new elements of the framework, including various levels of integrated microcircuits and various microprocessor devices, creates favorable conditions for the development of new high technologies. Computers working with a high level of data processing parallelism cause a number of problems that are difficult to solve in terms of the performance of computing and control systems and, on the other hand, the rational use of all available opportunities for the developers of this technique. Algorithms of operation of

control devices (logic control algorithms - ALU) are also implemented in software based on programmable logic controllers.

RESULTS

The need to cascade several decoders arises when the capacity of a single IC is insufficient to address a large number of different devices. For example, we have at our disposal decoder circuits for 2 inputs and, accordingly, 4 outputs. And it is necessary to organize access to 16 digital devices. Obviously, to build such a circuit, you need 4 decoder ICs with a fixed bit capacity. The first of them is $Q_0...Q_3$, the second - $Q_4...Q_7$, the third - $Q_8...Q_{11}$, and the last, the fourth provides signal output. - $Q_{12}... Q_{15}$. 4 inputs are required to enable selection of these 16 outputs - a_8, a_4, a_2 and a_1 . The two subs (α_2 and α_1) are fed to all decoders at the same time. The two highest ones (α_8 and α_4) are fed to the fifth decoder, which serves to select one of the four decoders for the output part of the circuit.

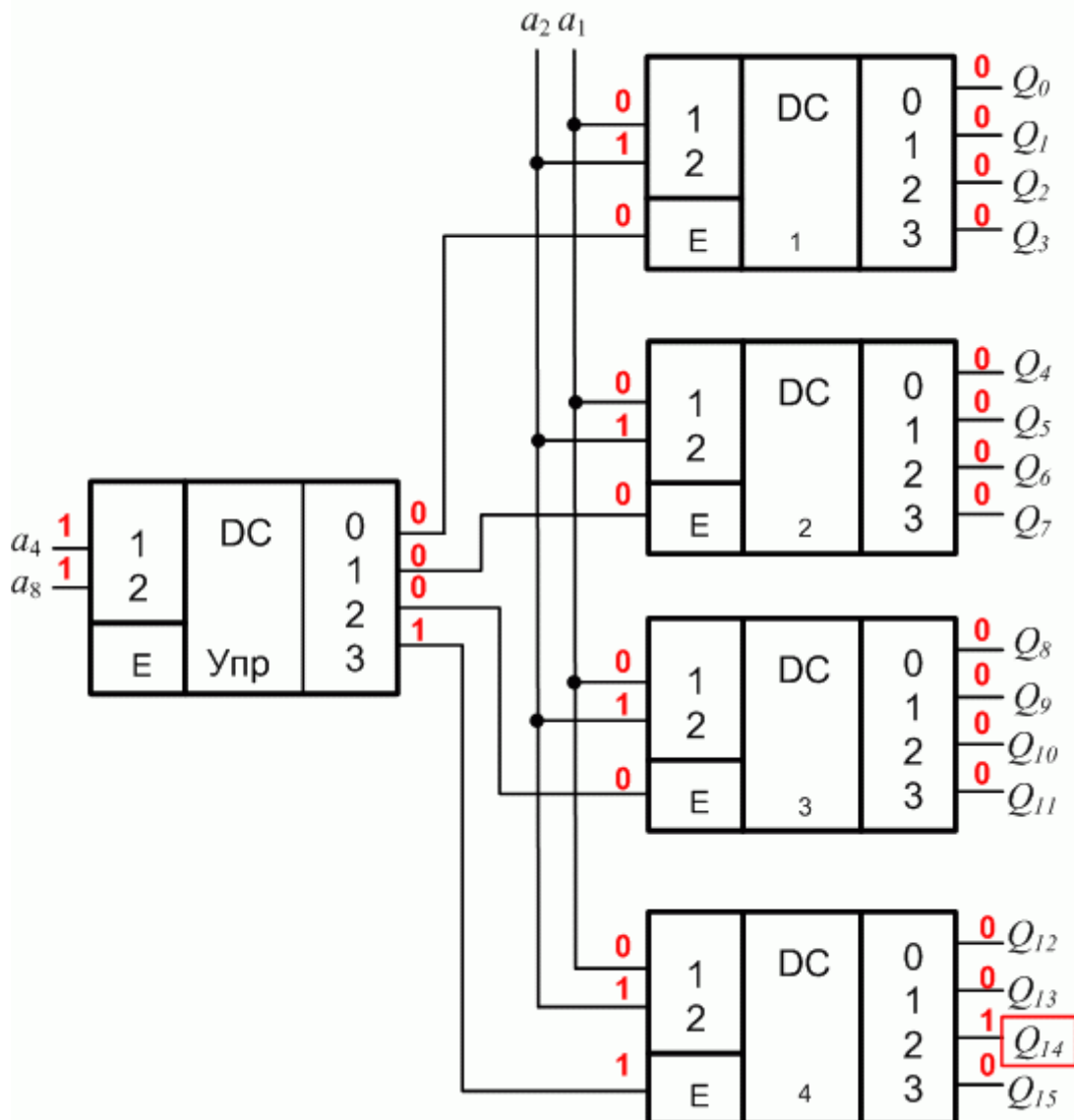


Figure 1. A cascade of decoders for 16 outputs based on 2 input decoders.

CONCLUSION

The working principle of the cascade is the same as a single decoder - it produces an active signal at only one output. The number of this output corresponds to the binary code applied to the input strings. For example, when applying the code 1110₂ (shown in red in Figure 1), only the fourth decoder of the output queue of the

cascade will work, logic zero will be applied to the activation inputs of the remaining decoders. Thus, logical zeros are generated at the outputs of the circuit Q₁...Q₁₁. And only in the active, fourth decoder, a unary code is generated - a logical unit corresponding to the code 10₂=2₁₀ at the input of this decoder at the output "2". Thus, the output of stage Q₁₄ will have a logic one corresponding to 1110₂=14₁₀.

References:

1. Алексеев В. Б. Введение в теорию сложности алгоритмов. М.: Издательский отдел факультета ВМиК МГУ, 2002.



2. Алексеев В. Б., Вороненко А. А., Ложкин С. А., Романов Д. С., Сапоженко А. А., Селезнева С. Н. Задачи по курсу «Основы кибернетики». Издательский отдел ф-та ВМиК МГУ, 2002.
3. Алексеев В. Б., Ложкин С. А. Элементы теории графов, схем и автоматов. М.: Издательский отдел ф-та ВМиК МГУ, 2000.
4. Боровков А. А. Курс теории вероятностей. М.: Наука, 1976.
5. Гаврилов Г. П., Сапоженко А. А. Задачи и упражнения по дискретной математике. 3-е изд., перераб. М.: ФИЗМАТЛИТ, 2004.
6. Дискретная математика и математические вопросы кибернетики, под редакцией С. В. Яблонского и О. Б. Лупанова. Т. 1. М.: Наука, 1974.
7. Евдокимов А. А. О максимальной длине цепи в единичном n -мерном кубе // Матем. заметки. 1969. 6. №3. С. 309–319.