Teaching Aspects of Contemporary Reprogrammable Devices

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Abstract – **The present paper discusses some aspects of the process of learning the operation with modern re-programmable devices of CPLD and FPGA type. A possibility is shown to use the mathematic notion "algebra" in assembling the learning programme. Some aspects of the programme suggested are discussed.**

Keywords – **Education, Programmable logic, CPLD, FPGA**,

INTRODUCTION

One of the explanations for the great expansion of digital technique in different areas of practice is connected with the use of modern re-programmable devices of CPLD and FPGA type.

The reprogrammable logic structures are in their essence high technology devices that define, form and dictate the tendencies in the development of the basic elements of electronic industry [1]. They possess excluding flexibility, high speed, excellent electromagnetic compatibility, high reliability and low consumed power. The realization of a comparatively not complex project with their help from its idea up to its practical application, which used to take weeks, is now done for hours. All this locates these devices in close proximity to the knowledge and dreams of any person in the field of electronics.

Despite of it, the questions having the attitude to the problems and methods how to teach the nature of these devices, together with their practical application remain not well described. Precondition and caused for this purpose suffices.

The first one is the absence of appropriate literature (in bulgarian), which explains in detail their essence and removes the psychological barrier about the practical use of the re-programmable devices. The second one is the lack of suitable methodology for their teaching. The third one is the insufficient attention paid to problems connected with the technological specifics implied by these devices use.

By itself the decision of these problems is rather simple.

The solution of the problems thus set is simple. It is expressed in the discovery of a form that will unite and control the process of teaching in operation with re-programmable devices, independently on their essence(digita or analog) or kind (CPLD or FPGA) type. This solution, no matter how strange, is found and offered by mathematics, in one of its basic notions – the notion "algebra". It exists thanks to indisputable logic, which enables the introduction of the abstract branches of modern mathematics in different areas of knowledge. Hence the question whether it is possible to use this notion in re-programmable devices area, is logical. Our answer to this question is firm and unambiguous - yes.

TEACHING ACCENTS

The notion algebra can be regarded in the general case as a triple of objects, including a set of elements, a set of rules for action with the elements and a set of constraints. The practical application of this notion for the purposes of teaching in the area of re-programmable devices defines accents on three objects:

Elements basis;

Rules of action with the elements basis;

Constraints concerning the features of the elements basis.

Some devices of CPLD and FPGA families of Xilmix are appropriate for use as elements basis in teaching. The main motive for this orientation is their easy accessibility, attractive price and user-friendly environment.

The rules of action with the elements basis are dictated and defined by the characteristics of the developing environment. In this particular case we are oriented towards the integrated environment Web Pack 6.1 of Xilmix. At the first stage of teaching, when some main notions and concepts of the re-programmable devices are introduced, our

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preferences are connected with the application of a built-in schematic editor. Its accepting by the learners is of particular importance not only at the first stages of teaching, but also afterwards, when the functional connections of hierarchical and complex architectures are created.

The constraints, connected with the elements basis include all the features that can appear in the practical realization of a system with these devices. This category includes phenomena of the type parasite capacities, inference between channels, etc. Their incorporating in the lectures horrarium enables the direct connection with a number of other disciplines such as physics, electro techniques, signals theory, etc. Moreover, accounting the high speed of these devices, the surrounding logistic environment starts to play strong, and in some case dominating role. This defines the necessity to teach in parallel the discipline electronic apparatus construction and automation of the engineering job (circuit boards design). These considerations lie on the fact that the printed circuit board today is already not just a tool for mechanic mounting of the electronic components. Their location on the circuit board is not an exercise in topology, but a complicated problem requiring the solution of problems connected with amplitude and phase distortion, reflections, temperature modes, ways of elements mounting, etc.

The information concerning every of the directions above mentioned is presented in a graphical and tabular form in the teaching process. Due to the absence of a corresponding Bulgarian expression, word or notion, or in order to avoid any inaccuracy in the translation, the corresponding information is provided at many places in English. This will be a difficulty for everyone new in this area, but future doctors have to study Latin for a similar reason.

In order to enable the learners clear up the theoretic knowledge obtained in the area of modern re-programmable devices and also to develop their design abilities, several modifications of the apparatus tools have been developed (called kits). They are separated in several groups and allow the detail study of the properties of separate CPLD and FPGA devices.

The first kit enables the design of small, not complex projects with the help of CPLD devices of XC9500 series and Cool Runner-XPLA3. Their comparatively not high price enables wide access to a large group of users in and out of the University. The second group of kits is intended for students in a higher course of teaching. It is oriented towards CPLD devices from CoolRunner II series and allows the most complete and exact investigation, learning and application of all characteristics, realized at apparatus level. The third group of kits is intended for students in the last courses. It is oriented towards FPGA devices of Spartan II series and enables the investigation of software systems like Picoblase and Microblase, which is the first step towards the practical learning of the process of built-in systems design (SoC).

CONCLUSION

We believe that the model thus presented for constructing a system for learning the operation with re-programmable devices may be realized on the basis of an apriori built sequence of stages [4]. These stages are: organization, information, interface and product. Each one of them is a ranked hierarchical sequence of different sub-stages in the design of every system for electronic teaching [5]. It is appropriate to use the so-called flow diagrams and the step model of the flow diagram when constructing the suggested model for re-programmable devices teaching. The implementation of these stages and of the flow diagram will enable the direct transfer of the model to the sphere of distant Web-based learning.

REFERENCES

[1] Ivanov, N. CPLD – yesterday, today and tomorrow. IIT Working papers, IIT/WP-116B, November, 2001 (in Bulgarian).
[2] Ivanov, N. Modern re-programmable devices. Sofia, Anubis, 2002 (to be printed, in Bulgarian).
[3] Labunets, V. G. Algebraic theory of Signals and Systems. Izdatelstvo Krasnoiarskogo universiteta, Krasnoiarsk, 1984 (in Russian).
[4] Monov K. Ch., I. S. Simeonov. Modeling and construction of a multimedia script of a system for distance e-learning on “Analysis and Synthesis of Logic Circuits”. Advanced Control Theory and Applications, June 16 – 29, Plovdiv – Gabrovo, Bulgaria, 2003, pp. 119-123.
[5] Dette, K., Multimedia und Computeranwendungen in der Lehre, Springer Verlag, 1992.