Using Hypermedia for Complex Technologies Education

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Abstract

Complex Technologies are very difficult to explain because they include a lot of related concepts comprising a large number of non-excluding or excluding subconcepts. Usually, complex technologies education is based on the analysis of specific devices of several manufacturers, but this method is not suitable because it gives only a particular insight. This situation demands a new methodology that summarizes all the characteristics of a particular technology and makes a dynamic link between the related concepts possible.
From this perspective this paper describes an original method for the characterization of complex technologies and proposes the hypermedia technique as a suitable solution for its practical implementation [1]. The method has been applied for teaching Programmable Logic Devices (PLDs), a very complex technology that constitutes one of the most dynamic areas of Microelectronics [2].

Introduction

In the twentieth century, technology has been characterized by a gradual increase of the complexity of any systems and greater interaction between them. As a consequence, the use of traditional educational methods makes the training of experts in certain technologies difficult. These technologies, that are called complex technologies in this paper, are characterized by a very rapid and chaotic development. This is caused by the interest of manufacturers in obtaining a dominant market position, promoting their trademark through the development of own products, which are different to those of other manufacturers but with similar functionalities [3][4].
The previous situation causes a lack of an adequate method for the analysis and characterization of complex technologies. This motivates the interest in developing new methods for the teaching of those technologies.

Characteristics of the complex technologies

We define complex technologies as those technologies including a lot of related concepts, comprising a large number of non-excluding or excluding subconcepts.
A complex technology has a set of general characteristics (common to all systems) that defines the systems included in it. These characteristics, that are called basic concepts, can be described by means of other ones named subconcepts. The subconcepts are the particularities that distinguish different systems included in a same technology. The related concepts and subconcepts that describe a particular technology can be structured into different levels to obtain the descriptive model of figure 1.

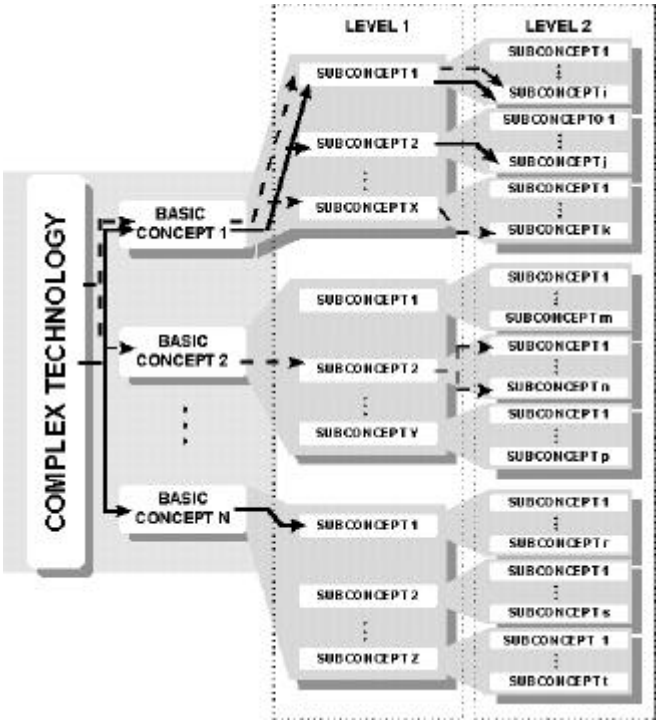

Figure 1 Characterization of a complex technology. The descriptive model.

The descriptive model encloses all the characteristics of a complex technology and combines the concepts in such a way that any commercial system or device can be described from it. As any concept or subconcept can contain others, the model has different levels that go from non-excluding to excluding concepts. In this way to analyze a particular system it is necessary to go through the model in an appropriate way.

According to the previous analisys, all the systems that below to a complex technology can't be described by means of a unique route that links all the related concepts of the descrptive model, but following different routes. In this way, the analisys of each individual system is associated with a particular route of the model. For example, in figure 1 the dotted and the solid arrow represent two different systems.

A method for the analysis of complex technologies

The method proposed in this paper for the study of complex technologies comprises of four principal stages (Figure 2).

In the first one, a lot of representative different systems or devices are chosen and analyzed. In the second stage all the common characteristics of the chosen systems (basic concepts) are determined and classified.

The third stage comprises of the definition of the particular characteristics associated to each one of the chosen systems describing each one of the basic concepts previously determined (subconcepts: including functionality, implementation, architecture, etc.).

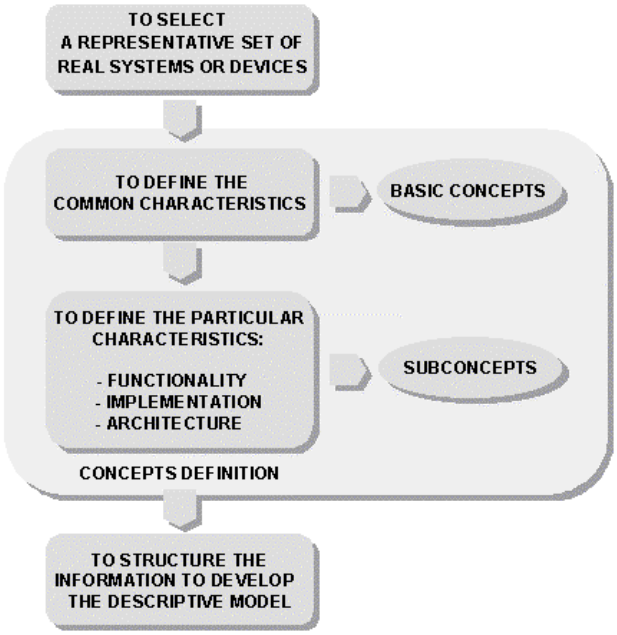

Figure 2. A method for the analysis of complex technologies.

Finally, all the basic concepts and subconcepts are structured to obtain a descriptive model.

Once the descriptive model has been obtained and tested, it is necessary to choice the way in which the information will be presented.

Although the descriptive model of a complex technology is very helpful, it can not be analyzed sequentially because it is frequently necessary to come back to previous concepts. The printed books, databooks, or tables are linear documents. For this reason they are not suitable for the characterization of complex technologies with a multiroute structure (Figure 1).

From this perspective, an alternative solution that allows navigate through the information in different ways (according to the system that is been analyzed) must be established. This constrain turns hypertext into a very useful tool to present a descriptive model for the analysis of complex technologies [5] [6] [7].

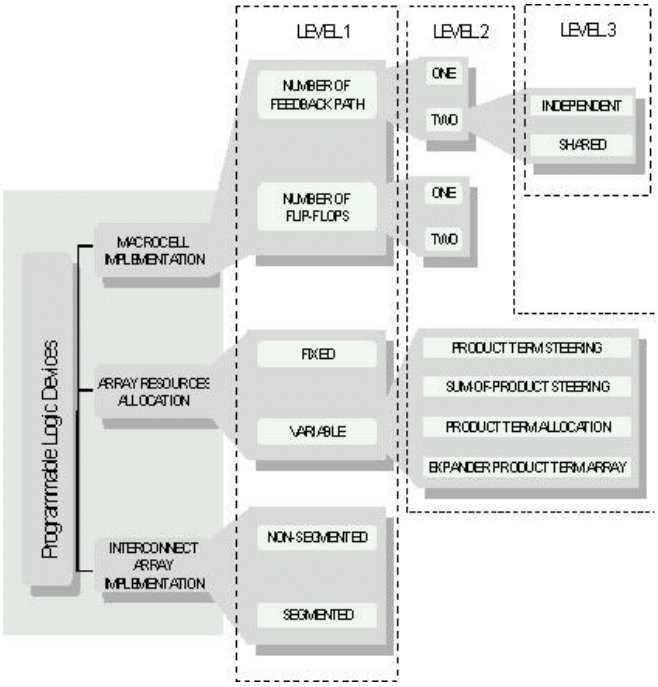

Figure 3. Descriptive model of the PLD technology.

Using hypermedia for the analysis of complex technologies

The principal advantage of hypertext documents is that they are non-linear documents, meaning that they can be read in several ways, and there is neither a unique nor a pre-defined way. Different concepts can be linked and accessed from any point of the document. At the same time hypertexts can link with other documents and software.

Another advantage of hypertext documents is that they can be combined with powerful audio-visual resources (figures, sounds, and animations) to develop a hypermedia application [8]. This is specially useful to present many concepts which are very difficult to explain by means of words. In the case of complex technologies their great hardware complexity demands the use of a lot of graphic information for the better understanding of their architectures.

Applying the proposed method for teaching PLDs

The method described before has been applied for teaching Programmable Logic Devices (PLDs), a very complex technology that constitutes one of the most dynamic areas of Microelectronics.

In the case of Programmable Logic Devices education the analysis of a lot of different commercial PLDs led to the classification shown in [9] and [10]. Using the proposed method we obtain a PLDs descriptive model, that provides students with didactic material that summarizes all the aspects of the technology (Figure 3). In this way their education is not reduced to the analysis of a few real devices.

For the presentation of the information a hypermedia tool oriented to PLDs education was developed. This application introduces the descriptive model of the technology, combining a lot of audio-visual resources to help students during the learning process. Figure 4 shows an screen of this tool.

Using the multimedia application the students can navigate over the entire application to analyze all the characteristics of the technology or through the links that combine the characteristics of a particular device. In addition, this application links with CAD tools of Altera [11] and Xilinx [12] thereby helping the student to go from theoretical concepts to real applications.

Conclusions

In summary, this paper introduces an innovative method for complex technologies analysis and education based on hypermedia. Applying this method a hypermedia application oriented to PLD education has been developed, providing students with a very useful tool that combines theoretical and CAD tools in the same environment.

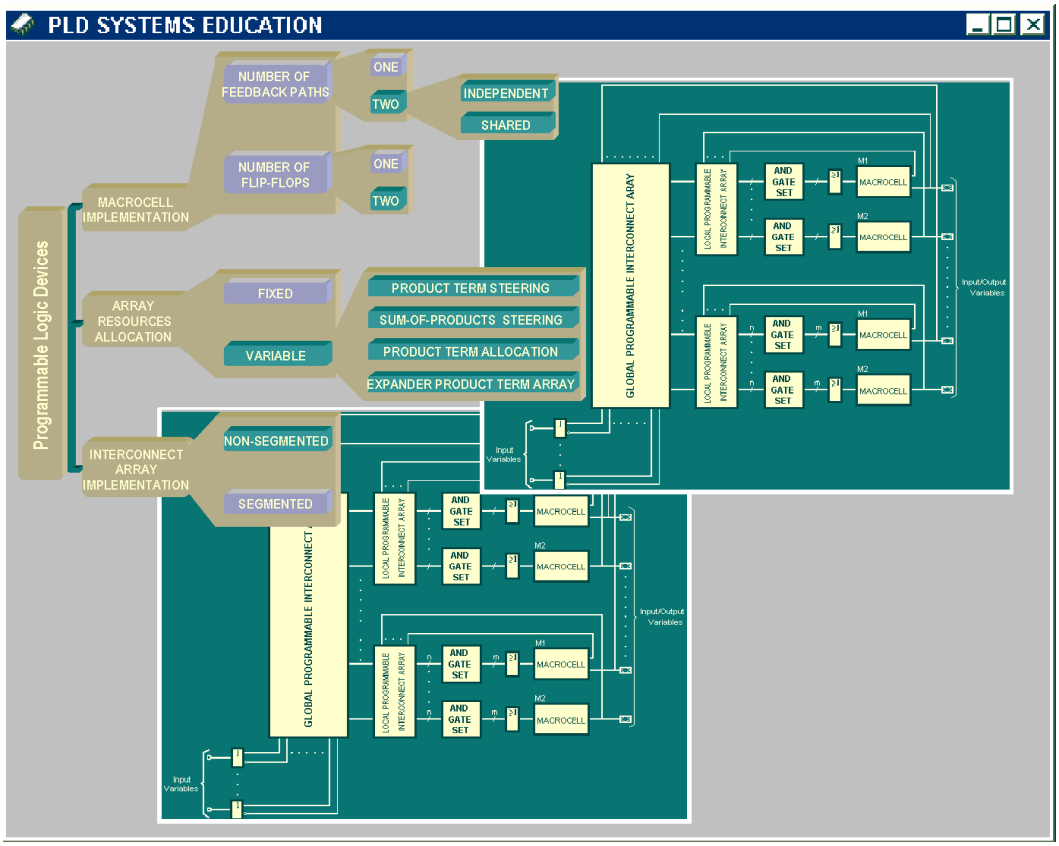

Figure 4. Hypermedia application for PLDs education.

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