

Development of a Web based Education Module for Verilog HDL

Rifat Shima and Liakot Ali

**Institute of Information and Communication Technology, Bangladesh University of
Engineering and Technology, Postcode 1000, Dhaka, Bangladesh**

Abstract

Now a days web-based education is getting popularity all over the world since it provides a platform to make education easy, cost-effective and wide-spread to the people. This paper presents web based education module for Verilog Hardware Description Language (HDL) which is an industry standard procedure for advanced electronic design and automation. The materials have been used in different lectures and short courses and it has been proved effective. It provides a platform for easy learning of Verilog HDL to the students of the university and VLSI designers in the industry. Web-based Educational (WBE) module for other engineering courses can also be developed following the similar approach as presented in this paper.

Keywords

Verilog HDL, e-learning, Web-based education

1. Introduction

In today's semiconductor world, millions of transistors are being integrated on a single chip which is completely impossible using conventional design technology. Industries are now using Hardware Description Language (HDL) based design approach for designing such kind of chip because HDL offers many advantages over conventional design approach such as shortening the design cycle, improving the design quality and lowering the cost of design [1-2]. Among different types of HDL, VHDL and Verilog are the two most popular, widely accepted, vendor independent and IEEE standard HDL. VHDL is mostly used in the European countries whereas Verilog is used in the USA and Asian countries. Due to enormous importance, they have been integrated with the syllabus of digital design courses of the undergraduate and postgraduate level in many universities. Many Books are written on Verilog HDL [2-5]. The focus of the books are more towards language rather than HDL as a design tool. Moreover a book usually provides the information in such a way that a busy reader may get bored. To overcome this problem a number of research projects have been carried out and among them web based education technique has been accepted worldwide. In the recent years, research on e-learning has got a momentum with the improvement of networking technologies and remote access capability [6]. With the help of web based approach, teaching and learning can be freed from the boundaries of classrooms and the class schedules. Now a days, a lot of research is on-going on different issues of internet based school, virtual colleges, remote laboratories to make education easy, cost-effective and wide-spread to the people [7-8].

Web-based educational modules for HDL can provide an easy and effective source of information. It will also be well-suited for students of different backgrounds and will be an interesting and interactive means for the reader to learn HDL not only by reading but also by doing. With the said objective, Web-based educational modules for VHDL has been developed and proved effective for the VHDL users [9]. In this paper, web modules for Verilog HDL are developed to meet the student's need in the University as well as that of Verilog user's in the industry and research organization.

2. Development of Web based Education Module

The Web is the way of linking text, images, sound, and video resources on computers that are connected to the Internet, the worldwide network of computer networks. The power of hyperlink (which is usually used in web based education) is that in a hyperlinked document if one wants more information about a particular subject mentioned, one can usually "just click on it" to. Traditional lectures and teacher's presentations can become multimedia learning experiences for students. The educator can link material in different formats, such as text, video, and audio, to make the teaching materials more interesting and animated. In addition, students are provided with a flexible learning

environment. They are not limited by the time or classroom any more, but can access multimedia educational material at their convenience [7].

2.1 Requirements of WBE Module

As for the educational module, it is important that we have not only good teaching material, but also a good organization of the material. Usually, a person learns by doing. One easily becomes bored when reading a “page by page” material. Hence educational modules should be interactive and interesting, and encourage the student to search for more information. The major requirements of a WBE module are: (i) the WBE module should be an effective source of information for the user. The teaching materials should be carefully chosen, based on the interests of the reader. (ii) the WBE module should provide an efficient way for the reader to get information. The teaching materials should be organized properly so that the reader can easily find the information. (iii) the WBE module should be suited for various users of various levels. Links to the topics with different detail and other related the designer should provide materials. It is the reader who decides how much detail to learn (iv) the WBE module should be interesting and interactive so that the users are encouraged to interact with the module.

2.2 Technology Used in Developing the WBE Module

The following software is used in developing the proposed WBE module:

Joomla: Joomla is a powerful Open Source Content Management System (CMS) for developing web page [10]. A Content Management System is a piece of software that keeps track of every piece of content on web site, much like local public library keeps track of books and stores them. Content can be simple text, photos, music, video, documents, or just about anything one can think of. A MySQL database is created when Joomla is installed

Navicat: For user interface of MySQL, Navicat tool is used. Navicat is an ideal solution for MySQL administration and development [11]. This is an inclusive MySQL front end that provides a powerful graphical interface for databases management, development and maintenance.

Wamp5: Wamp5 is used as a web server. WAMP is for Windows - Apache - MySQL- PHP5. WAMP5 automatically configures them to work together. During installation, a "www" directory is created in WAMP5's directory. Script files (php files) have to put in this directory and access localhost threw an Internet Windows or the service manager (icon tray).

Quartus II/Maxplus II: Quartus II and Maxplus II are used for digital design and simulation. Quartus II and Maxplus II are two powerful EDA tool that provides a complete, multiplatform design environment for system-on-a-programmable-chip (SOPC) design [12]. It supports system-level design, FPGA and CPLD (complex programmable logic device) design, synthesis, place-and-route, verification and device programming. Quartus II design flow is presented in Appendix A3. Each stage of design flow can be invoked from the GUI of the Quartus II.

2.3: WBE Design

The design of a web site is an abstract view of the developed system. The design of the web site ensures that it will fulfill the requirement of the proposed system. As from requirement analysis, the proposed WBE is divided into four parts as shown in Figure 1. Education Material Bank Menu is the most important part of the WBE. Our materials are extracted analyzing majority of the available literatures as well as our research and design experience on Verilog HDL. A number of research publications are included in menu. So the learner can get advanced knowledge about HDL. This menu provides list of tools that are used for Verilog HDL coding. To view the list of tools user has to click on the tools menu. By click any tools user can visit a web site related on that tool. This menu provides some useful tutorial site of Verilog HDL. To view the list of tutorial sites user has to click on the links menu.

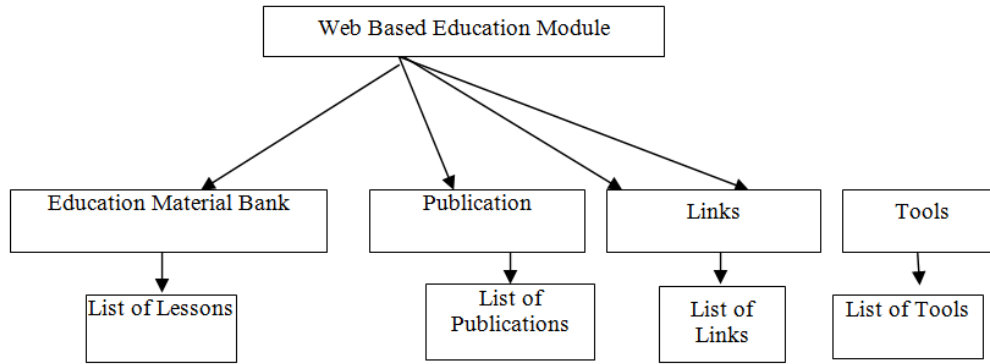


Figure 1: WBE design view

3. Results and Discussions

This WBE module is a menu driven application. It has four menus and they have sections, subsections to present some links or contents. Figure 2 shows the initial screen of the application. At the top, the page contains the banner on the WBE. The theme title of the WBE is “**Increase Your Silicon Programming Power**”. At the left side of the page it contains menu bar. Menu bar contains five menus. Each menu can be accessed from this section. At the middle section of the page it contains the features and their brief description.

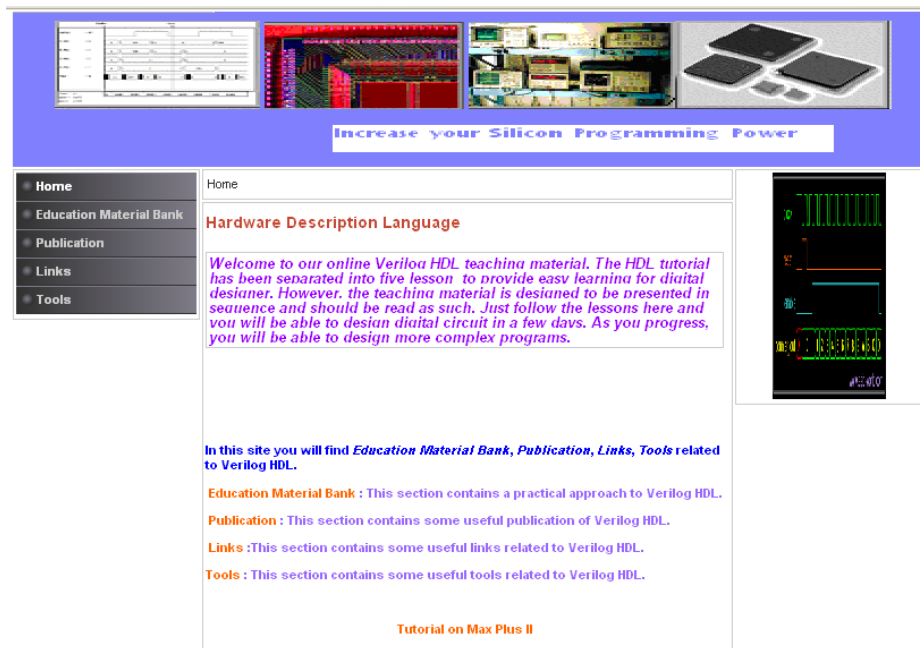


Figure 2: The initial screen of the web based education module

Some of the important snaps of the WBE are shown in Figure 3, Figure 4 and Figure 5.

Verilog HDL - 4.6 Example of Desi...

From the above Truth Table, it reveals that the relation between output and input is: output can be achieved by adding 3 with the input.

```

module bcd_ex3(BCD, EXS3);
input [3:0] BCD;
output [3:0] EXS3;
reg [3:0] EXS3;
always @(BCD) begin
EXS3=BCD+4'b0011;
end
endmodule

```

Simulation result of a circuit

Verilog code of the circuit

Simulation output of bcd_ex3

```

//Example: Design a 4-bit ALU (Arithmetic Logic Unit). The circuit performs two arithmetic and two logic functions that are selected by a 2-bit input. The four operations are add, subtract, AND, and OR.
module ALU(A, B, S, Y);
input [3:0] A, B;
input [1:0] S;
output [3:0] Y;
reg [3:0] Y;
always @(A or B or S) begin
case (S) begin
0: Y=A+B;
1: Y=A-B;
2: Y=A & B;
3: Y=A | B;
end
end
endcase
endmodule

```

Figure 3: Snap showing content of education material of a section

-Distance teaching over Internet

Home • Links

Web Link

- Verilog Introduction for Digital Design
- Verilog Tutorial
- Information on HDL's and scripting Languages as applicable to Chip design
- Designer's Guide to Verilog
- Online Verilog-1995 Quick Reference Guide
- Verilog Interactive Tutorial
- Verilog Simulation
- Digital Computer Arithmetic Datapath Design Using Verilog HDL

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Figure 4: Snap showing important web links for learning Verilog HDL



Figure 5: Snap showing important publications on Verilog HDL

Figure 3 shows the snap of content of education material of a particular section. It also shows the Verilog code and simulation result of a circuit for better explanation and understanding for the Verilog user. Simulation results make the web page more animated as well. Several simulation results are provided, and the reader can select by simply clicking on the various links. This method encourages the engagement of the reader. Figure 4 shows web links for some useful tutorial site of Verilog HDL. To view the list of tutorial sites user has to click on the links menu. On clicking the link, the home page of that web site will be appeared. User can access any of the pages from that site. Figure 5 presents the snap showing important research publications. The learner can get advanced knowledge about Verilog HDL using the feature of the WBE.

3.1 Important Features of the WBE Module

Some of the features of the WBE are as follows:

Comfortable Learning Environment: Our WBE makes the reader feel comfortable and assists one to easily search for detailed information. The background colors of our browser windows are carefully chosen so that the contrast is suited for reading. In order to help the reader to capture the information, different fonts are used to differentiate the sub-topics and the textual explanation. The reader can quickly go through the topics before reading the detailed contents.

Providing Step by Step Explanations: In order to improve the readability of the examples given in the education materials, long textual explanation has been replaced by a step by step learning process. Each circuit design is explained first then the Verilog code of the design, at last the simulation result is given.

Making an Interesting Learning Environment: Effort has been made to make the web page interesting and assist the reader to understand the teaching material. For example, images are frequently provided along with the textual

explanation. Uses of several figures illustrate the design process step by step. Images make the teaching materials animate and help the reader to understand the textual explanation.

Showing Simulation Output in Image: The simulation result is presented in image format in WBE, which makes the web page more animated as well. Several simulation results are provided, and the reader can select by simply clicking on the various links. This method encourages the engagement of the reader.

Easy Browsing of the Web: It is common that a reader will go back or forth when reading a book. Appropriate links are given so that readers can easily either follow the teaching materials or choose the topics from the “Table of Contents”. Large topic is divided into several pages and is given links of those pages. So the reader can easily access the page from first to last.

4. Conclusion

Web based education is now a popular and world wide accepted technology for teaching and learning. In this research an effort has been made to develop a web based education module for Verilog HDL. It provides a platform for easy learning of Verilog HDL to the students of the university and VLSI designers in the industry. It is user friendly and well suited for the learners of different depth of knowledge of HDL. Learner can easily extract information from very basic to the advanced level of Verilog HDL using the WBE module. It is not only limited with teaching materials. It is a package of learning Verilog HDL. To make the WBE module interesting and interactive research publication, tools, tutorial site related on Verilog HDL has been integrated. The education materials have been used in the Postgraduate Classes on Advanced Digital Design in the IICT, BUET, Dhaka as well as in several short courses on Verilog HDL. The user’s comments on the material are very good. Thus the learner can get all kinds of information, resources from this WBE module. As a part of future work, the WBE it can be made dynamic so the course material, publication, links, tools can be regularly updated.

Acknowledgements

The authors like to gratefully acknowledge to Bangladesh University of Engineering and Technology for allowing conducting the research using its all kinds of facilities.

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