

E-EVALUATION OF PROTOTYPING BOARDS

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Abstract. In our paper we present a set of web-based tools created to permit the remote access to prototyping boards used to implement and test hardware-software applications. The tools provide a set of web-based interfaces to different remote prototyping boards containing programmable logic circuits (FPGAs/CPLDs) and microcontrollers. Mixed hardware-software designs can be experimented remotely allowing the evaluation of the prototyping boards from any location on the Internet (e-evaluation)..

Keywords: e-evaluation, FPGAs/CPLD synthesis

Introduction

Evaluation of prototyping boards can often be a costly and long process for both vendor and client. Costs for handling and shipping of the prototyping board and documentation at far locations in the world, refunds for unsatisfied customers, initial investment paid by the client for the kit, can be reduced if there is a way to make the evaluation before buying the prototyping board.

The evaluation of a product is a process in which the user has the possibility to get familiar with and test the product before buying it. Usually a potential user makes a request to the manufacturer or a vendor of a product for an evaluation copy. The evaluation copy is shipped to the user who has a period of time to try all or the most important product features or functions of the product. At the end of the evaluation period, he must decide to buy the product or not. In the second situation and sometimes in the first one (in order to obtain a full featured or full functional product), the evaluation copy must be shipped back to the vendor.

As we can see the evaluation implies costs from the part of manufacturer/vendor and smaller cost can also be in charge for the potential user.

A possible way to reduce evaluation cost is giving to the user the possibility to evaluate the

product from his work place or from home without shipping any evaluation copy.

In our days more and more people have Internet access from their work, have their own PCs connected to the Internet at home or have access to Internet cafes.

This brought us to the idea of creating a set of web-based tools allowing remote access to prototyping boards in order to evaluate them from remote locations.

We define the e-evaluation of a prototyping board the process of evaluation of all or part of the features of a prototyping board from a remote location using only a computer connected to the internet and running a usual web browser. Additional software may or may not be necessary to be installed on the user computer.

The authors are developing a set of tools which can offer remote access to a set of prototyping boards used in the laboratory of digital design. Based on the experience gained in setting up a remote access to a prototype board [1], the work was extended in order to make reachable, from remote locations, at the same time, three other prototyping board types existent in the lab. What we have obtained is a remote system people can use to evaluate the prototyping boards from outside, at convenient hours, using a PC connected to the Internet.

The remote access to the prototyping boards is achieved using a set of web-based tools. Using this set of tools, one can first load his designs into the boards and then test their operation by sending test vectors and getting back information about the signals in the running design. Because the prototyping boards contain both programmable circuits and microcontrollers, one can load and test mixed hardware-software designs.

Prototyping boards

Prototyping boards are usually intended for early testing of a design. A change in the list of components, wiring and even architecture of the design is expected in this stage.

In our paper, we are addressing especially prototyping boards for microcontrollers, programmable logic circuits and those that use both types of these circuits. The last category of prototyping boards are conceived in either one of the following variants:

- microcontroller is the main component on the board. In this case the programmable logic circuit is included mainly for implementing the glue logic necessary for interfacing the microcontroller with other on-board or external components
- programmable logic circuit is the main component on the board. The microcontroller is used for implementing the interface between the prototyping board and the PC that allows the user to download the configuration files to the programmable circuit
- the board is conceived for prototyping mixed hardware-software designs and therefore the microcontroller and the programmable circuit have same importance on the board.

In the area of digital design, the introduction of programmable logic circuits and especially the field programmable ones have made prototyping easier. One can obtain modification of wiring, architecture and even components (in terms of logic gates or basic logic blocks) through the programmability characteristic of the programmable circuit.

From the functionality point of view, the components on the prototyping board can be put into following categories:

- main component(s): microcontroller or programmable circuit
- power supply connector and voltage regulators
- memory circuits: RAM, Flash, EEPROM,
- input devices/circuits: potentiometers, switches, pushbuttons, keypads, ADCs etc.
- output devices/circuits: leds, seven-segment led, LCD displays, speaker, DACs, codecs etc,
- input/output ports: serial/parallel/Ethernet/USB communication port, PS/2 port (mouse, keyboard), VGA port,
- other components: resistors, capacitors, jumpers etc.

From the point of view of user accessibility, the components can be directly or indirectly accessible. For example a push button is directly accessible (it can be pushed with the finger), a led is directly accessible (its lit on or lit off status can be visualized) while memory is indirectly accessible (we can not store specific data or tell if that data is stored in the specified location without using a suitable tool).

In order to allow the prototyping board to be evaluated the evaluation system must address the following issues:

- technical issues: connection of the prototyping board to the Internet; provision of access to all or main components of the prototyping board in the same or similar ways as if one works directly with the board; evaluator must use the same software tools; elimination of erroneous usage that might damage the board etc,
- management issues: registration of system users; assurance of single and protect access to the prototyping board; multiple access or access to multiple prototyping boards; determination of available prototyping boards etc,
- power management and well-functioning issue: prototyping board initialization and tracking, implementation of a power saving procedure for the period the prototyping boards are not in use.

System architectures

The e-evaluation system can have different architectures depending on the characteristics and features of the prototyping board. One important characteristic is the way the prototyping board connects and interacts with the PC.

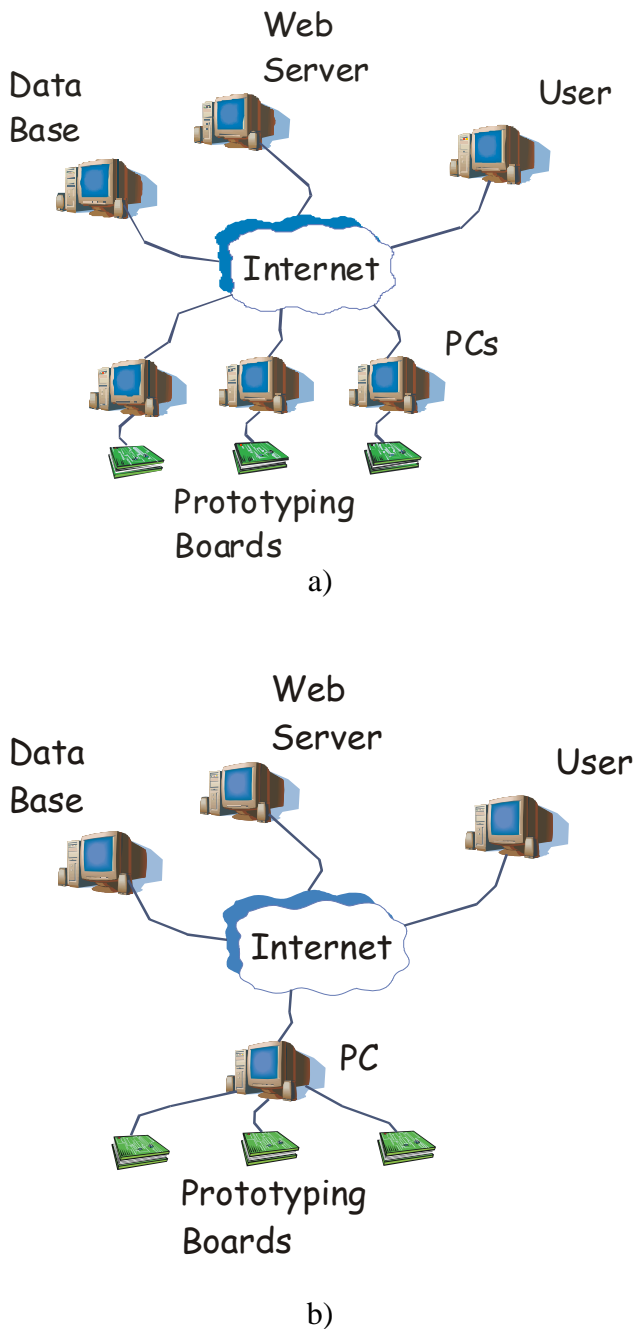


Fig. 1. Connection of prototyping boards to the Internet: a) multiple PC configuration, b) single PC configuration.

Most of the prototyping boards are connected to the PC using the serial or parallel port. New prototyping boards can be connected to the PC using the USB port. Usually a PC has 1 parallel port, two serial ports and two or more USB ports. Thus, there is a limitation on the number of prototyping boards that can be connected to a PC and usually one PC is needed for each prototyping board (Fig. 1a).

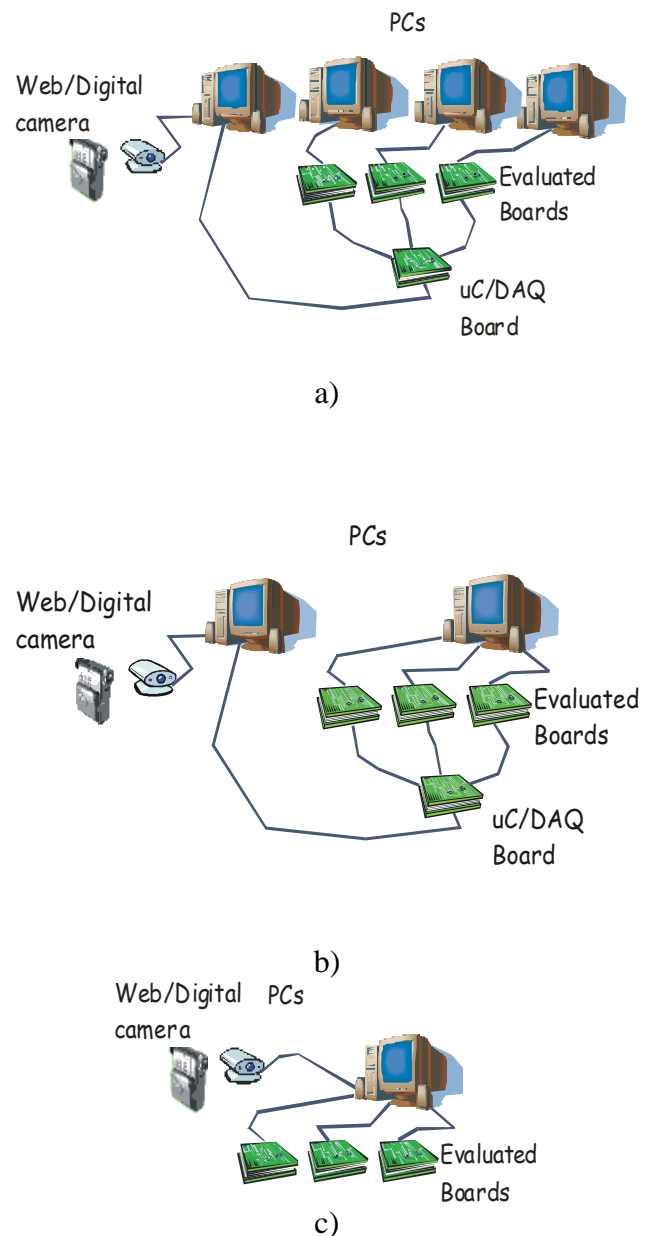


Fig. 2. Feedback from the prototyping boards: a) multiple PC configuration, b) single PC configuration, c) single PC configuration, single communication line for each prototyping board.

Parallel port or serial port extension cards are available from different manufacturers at convenient prices. When such cards exist, more than one prototyping board can be connected to one PC (Fig. 1b). Same configuration can be used when multiple USB ports are available or using a USB hub.

One important issue when e-evaluating the prototyping board is getting feedback from the board in terms of signals and status of the displaying elements (LEDs, LCD display). This information is needed when testing the operation of the design implemented on the prototyping board. We send test vectors to the inputs of the design and want to see how the outputs are changing. This can be achieved in different ways as depicted in Fig.2.

Different signals on the prototyping boards can be read using a microcontroller based board which is connected to the PC using a serial port or a DAQ card placed in the PC. The acquired information is then sent to the user and displayed in a convenient manner. Visual information can be obtained using a web or a digital camera connected to the PC and sent over the Internet to the user.

Software

For e-evaluation of prototyping boards, several software components are needed:

- design software: used for developing applications for the main components on the prototyping board. Usually this software must be purchased but, evaluation and even free versions of the software are provided by some manufacturers available;
- configuration/communication software: allows uploading/downloading programs and/or configuration files to/from the prototyping board using one of the PC ports: serial, parallel, USB etc;
- gateway software: communicate with prototyping board(s), perform data processing SSI and CGI, generate web pages;
- user interface software: interfaces the user with the e-evaluation system. It can use server side processing or user side processing. In first case all processing is done by the server so, only a

web browser is needed on the user side. In the second case, some processing is performed on user side. This requires for some programs or scripts to run on the user computer.

- system administration software: provides user registration, controlled access to the prototyping boards, tracking of user activity, generation of system usage statistics etc.

E-evaluation system example

We have realized a system denoted PROBES (PROtotyping Board E-evaluation System) that gives remote access to four types of prototyping boards from XESS [2]: XS40-005XL, XS40-010E, XS95-108 and XSA-50.

The characteristics of the prototyping boards and two architectures of the system we have used for e-evaluation are presented in [3].

In the first architecture, each of the prototyping board is connected to one PC using the parallel port. An 8051 microcontroller board is used to read the status of signals from the prototyping boards.

Components on the prototyping boards can be configured, read back and feed with test vectors using a parallel cable and the software provided by XESS Company [4]. A CGI script uses the line command version of the software to allow communication between prototyping board and user interface. Using this architecture one can use all resources available on the XS prototyping board.

Second architecture can be used to e-evaluate the first three prototyping boards taking benefit of the available on-board microcontroller. The information about the status of signal status on the board are read by the microcontroller and sent using the serial port of the computer the board is connected to.

In this second architecture, the use of the microcontroller and part of the programmable circuit to read and send information of signal status imposes some restrictions to the implemented design.

Users are informed of the restrictions this architecture imposes and the resources consumed because of the restrictions

The access entry point of the remote system is an html page containing links to the HTML pages corresponding to each of the prototyping board.

When entering on the page where users can make their selection, prototyping boards that are e-evaluated in that moment by other users are marked clearly and can not be selected (Fig. 3).



Fig. 3. PROBES prototyping board selection page.

The page also contains links to the different board manuals and to the available design examples.

Access to the HTML pages corresponding to the prototyping boards is password protected. One must first subscribe and obtain a valid password before he can get access to the remote system boards.

The HTML page for the prototyping board presents the image of the board and links to the html forms implementing the interface between the user and the system. Additional links offer the possibility of viewing the block diagram of the board, online help and design examples in three categories: hardware, software and mixed hardware/software.

In order to permit the access to as many people as possible, the time limit for a session is set to 30 minutes. When the time limit is exceeded, the connection is reset automatically by the server.

In a future version, an inactivity detection will be implemented reducing the time the board is occupied when the user no longer exercise it and forgot to sign out before expiration time.

The online help contains detailed instructions on how to access and use the remote system. It gives additional links to available software tools needed to design with programmable circuits, writing and debugging microcontroller programs, circuit schematics, tutorials etc.

Conclusions

We have presented some of the characteristics a system must have in order to allow remote evaluation of prototyping boards. An e-evaluation system for XESS prototyping boards realized by the authors is described.

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