Web Based System for Collaborative FPGA Design

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Abstract. The paper describes the architecture, functionality, implementation and user interface of a web based distributed system for collaborative FPGA design. It allows a group of geographically separated specialists to work together on a common project. The whole system is conceived as a development environment accessed through Internet by using standard web browser and FTP client.

1. Introduction

The increasing complexity and geographical separation of design data and a project's participants has created a need for a collaborative and distributed design environment. Its advantages are high scalability and performance.

Several distributed collaborative environments have been reported. Bentz have proposed an information based design environment in which the users collect and manage information in a uniform fashion [3]. Lidsky and Rabaey presented a Web-based prototype tool, PowerPlay, which helps in system-level exploration of power consumption [4]. Konduri and Chandrakasan have developed a distributed framework for Web-based CAD, in which designers can collaborate on a design over Internet [2].

All of these projects have their advantages and disadvantages. Konduri and Chandrakasan's tool is oriented to common drawing of a integrated circuit schematic. It permits many users to open, use and edit the same file. This may be considered as disadvantage because of users' confusion when more than one user edit on the same schematic. The edited schematic cannot be checked or simulated before all work is done. A designer may have to wait another one to finish his/ work before processing of the schematic simulation.

The advent of the Internet has opened new vistas in area of information access, and the World Wide Web has emerged as the most desirable platform for distributed access to information, enabling the designer to access professional tools from any terminal on the Internet [1]. Starting and executing tools appropriate for VHDL simulation and FPGA physical design through the Internet are reported in [5-7]. They do not take care about collaboration and communication problems.

There are many different tools and programs for FPGA design workflow from various companies. These tools have different graphical user interface (GUI), which normally changes in every new version. This creates difficulties even for experienced designers. More complicated situation appears when a new user has to be rapidly trained to use all of desired design tools.

To answer needs for user friendly and easy to learn design environment and the requirement for collaboration between geographically separated teams working on a common project a distributed system has been developed. The main aim is to collect available professional FPGA design tools in a single integrated design framework with uniform GUI ensuring in the same time all facilities to support collaboration.

2. System Architecture

Developed distributed environment for collaborative FPGA design combines different software tools in a single intuitive graphical user interface. It is important issue for rapid project's development. Centralized nature of project's repository guarantees that no mess of different project's file versions will happen. A bug-tracking module keeps in touch designers, and project's functionality testers. Communication between participants is organized by using web-based forum. There is no limit in additional modules' type and functionality that can be implemented in designed distributed environment. Advantages of new technologies are used, so implementation of new modules does not require reconfiguration of system's architecture.

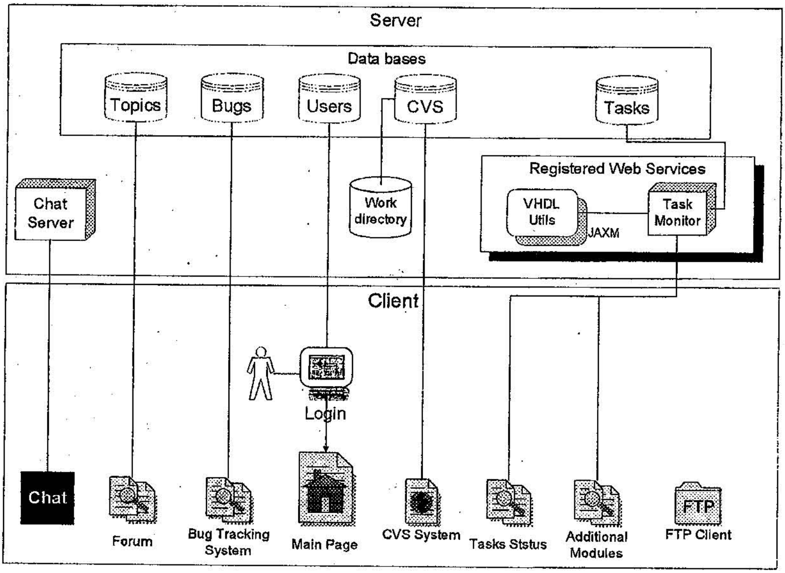


Fig. 1 - Architecture of created distributed environment

Architecture of created distributed environment is based on three-tier model (fig. 1). First tier is based on web browser (showing HTML, and applets), which represents client side of the system. Second tier consists of server side software. Java language is used in client and server side programming. JSP (Java Server Pages) mix static and dynamic data, the result is generated static HTML page that is displayed in client's web browser. Sun Microsystems's Servlet technology is used on the server side to accept user's requests. Servlets take care of execution, and monitoring of desired tools started on the server. Third tier of the system is represented by database containing information for users, project's bugs, forum's topics, and additional information for started system tasks.

Java technology makes software platform independent, so it can be easily transferred from one operational system (server) to another.

In created distributed environment is used JAXM (Java API for XML messaging) technology. It allows available system services to be registered as web services, so they can be easily searched and used from other network-based applications. Another main advantage of JAXM methodology is its asynchronous way of work. Participation of many different computers in a distributed system concerns a problem with information synchronization. Every single computer in a distributed system can be inoperative at some time, because of some hardware or software problems.

If a synchronous technology is used for information exchange then queries sent to inoperative part of a distributed system will be lost, and if they are essential for the work of the whole system, it may crash or begin functioning in undesired ways. JAXM is part of JWSDP (Java Web Services Development Pack), so advantages of WEB SERVICES technology can be used.

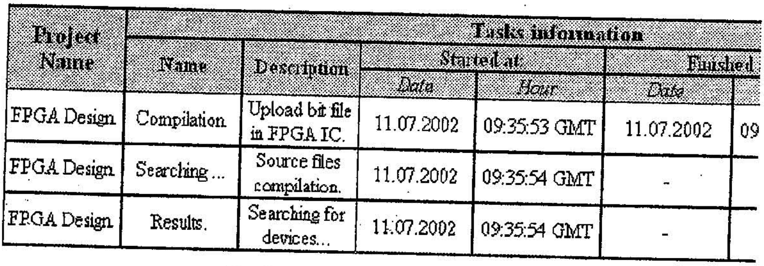
3. Modules and functions

Distributed FPGA system includes several modules with different functionalities. They are intended to feed the professional tools with required data to start the display tools and to return results.

Creating new system tasks – this module is designed as a servlet on the server side. Its aim is to prepare input data, control parameters and to start FPGA tools. In case of FPGA design professional software tools (VSystem VHDL simulator, Synopsis FPGA Express synthesis tool, Xilinx Foundation physical design software) are used. They are executed on a server machine, and "system tasks" module transfers appropriate information to the server. Every single tool's parameters and options are concerned in this way user is able to configure and supply all needed parameters to the desired design tool. Once a system task has been run, its status can be watched through another module called "Tasks Monitor".

Task monitoring – it is user dependent module. Every user can watch only tasks that he/she's started. A task can take a lot of time for its execution. Status of currently executable tasks is represented in a table. Part of this table is shown in fig. 2.

Any new system task should be registered to "Task Monitor", and then it is send to a tasks execution queue, which is on the server. Through "Task Monitor" it is able to control number of parallel tasks ran on the server.



Project Name	Tasks information					
	Name	Description	Started at		Finished	
			Data	*Hour*	*Date*	
FPGA Design	Compilation	Upload bit file in FPGA IC.	11.07.2002	09:35:53 GMT	11.07.2002	09
FPGA Design	Searching ...	Source files compilation.	11.07.2002	09:35:54 GMT	-	
FPGA Design	Results.	Searching for devices...	11.07.2002	09:35:54 GMT	-	

Fig. 2 – Table with Task Monitor's tasks.

Bug report system module – practically it is impossible to create a software or hardware product, which is bug free – at once. "Bug report" module contains bugs report and bugs removing reports. When at project's testing a bug is found then it is reported to bug reporting system. A specialist responsible for this bug is also responsible for its removing. When the bug is debugged and fixed, project goes once more through the testing procedure, if bug is really removed from source files then it is removed also from bug reporting system, otherwise bug is considered as still existing.

Information exchange (forum) – when many people work on a common project, it is essential to keep them informed for project's status. This problem is solved by creation of "Forum" module. The aim is to expose problems, which arise during project development. In this way problems can be solved much faster, and all project's participants may use the teamwork advantages.

Real-time information exchange (chat) – this is much more fast way for communication than "forum". Any online user can see other online colleges who work on the project. It is easy to inform them immediately for some important event. Main advantages of developed module are:

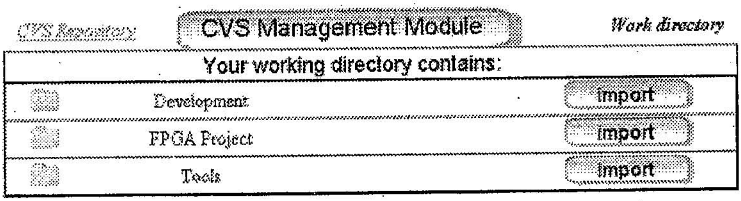
- *mobility* – this is web based chat (there is no need to install any additional software), accessed only from registered users.
- *"forum" connection* – is added to this module. It is connected with "forum" module, so if any user wants to watch some forum's topic then he/she can be registered to receive messages when status of desired forum's topic changes.

Concurrent Versions System (CVS) – a module using such system is created. GUI of this module is shown in fig. 3. The idea is to store project's files in a safe place and at the same time to control every single file's version. Concurrent Versions

System creates rules for files used by more than one user. Main advantages of this system are:

- It is able automatically to merge text files – in this way more than one designer can work on one and the same file. Changes made by them are applied to the file in the CVS system.
- Older files' versions are kept in CVS repository – when older file's version is needed it is easy to get it from repository.

Every single user has its own working directory on the server, where he/she can download working copy of a file from the CVS repository. File transfer between user's current computer and user's work directory is established by using FTP software client.



Your working directory contains:

Development
FPGA Project
Tools

Fig. 3 - Screen shot of "CVS Management" module

4. Graphical User Interface - GUI

Designed collaborative distributed system uses graphical user interface. It provides easy navigation between modules (fig. 4). The system is open for incorporation of new modules. They are accessed through hyperlinks to web resources. Adding a new module will not change other modules' design or program logic. Hyperlinks are represented as a GUI buttons.

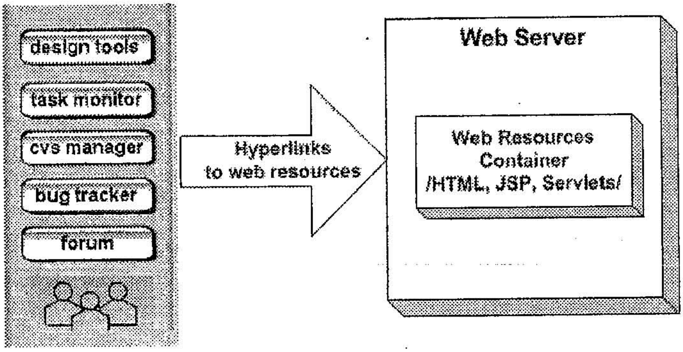


Fig. 4 - Distributed environment's GUI

Conclusion

Developed environment for collaborative FPGA design allows specialists from different geographical locations to work together on a common project.

Architecture of the distributed environment is based on three tier model which includes – client side (web browser), server side allowing execution of FPGA design software, and third tier containing data bases for users, and any additional information for the project. This architecture is implemented by using new Internet technology

- Java language
- Applets – client side
- JAXM (Java API for XML messaging), which is part of Java Web Services Development Pack
- Servlets and JSP pages– server side
- Asynchronous communication between different parts of distributed system

All these ensure great scalability, reliability and platform independence.

Benefits of designed system for collaborative FPGA design are as fallows:

- Access to environment via standard web browser
- Intuitive graphical user interface
- User managed access to environment
- Easy implementation of new modules

Developed distributed system for collaborative FPGA design is tested in the project-based learning pilot course in ASIC Design delivered within a framework of Netpro II EC Leonardo De Vinci Project.

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