Abstract

With the growing complexities of the VLSI circuits and systems, Computer Aided Design (CAD) and synthesis are becoming increasingly complex. In order to reduce the design cycle time for such circuits, it is necessary for the CAD environment to have an efficient design methodology. Such a design methodology should deal with the design process at a higher level of abstraction and would synthesize an efficient hardware of a circuit from its specification. In view of this, it has been observed that the object oriented design methodology, which has already been quite successful in developing complex softwares, can also be very effectively applied in modeling hardware systems. Potentially, an object oriented modeling, allows an uniform interface of heterogeneous design data, supports hierarchical design, reuse of existing design information, management of different versions and views of a design, integration of CAD tools etc. An object oriented methodology can be suitably applied in synthesizing circuits as well, where one can build a complex system in terms of off-the-shelf components, thereby reducing the design effort to a great extent.

This thesis presents an object oriented design framework called DOORS for designing digital circuits. In DOORS, circuit elements, modeled as objects, are stored in a design library, built upon an object oriented database. Here, a designer can build a circuit from presynthesized components rather than always designing them from scratch. A hardware description language, OHDL, has been developed for circuit specification. The synthesis system accepts an OHDL specification of a circuit and synthesizes its structure. OHDL allows the usage of presynthesized components from the design library while describing a new circuit. The proposed synthesis system identifies such presynthesized components and integrates them in the datapath of the circuit being synthesized, rather than resynthesizing them once again. However, such an integration does not merely imply placing a presynthesized component in the datapath, but also demands its input/output requirements to be satisfied. To do so, DOORS maintains an adequate interface information of every presynthesized component in the design library, which is utilized by the synthesis system. Moreover, the components may communicate among themselves and transfer data. Synchronization of these data transfer operations among the components are taken care of by the synthesis system. Subsequently, its datapath and controller are generated. Before storing a synthesized circuit in the design library, DOORS verifies whether the circuit can at all be reused later. Such a verification is based on a concept called *external controllability* of an operation. The external controllability of an operation is verified from the control and data flow information of the circuit. Once a circuit is found to be externally controllable, it is stored in the library.

DOORS have been applied to synthesize several real life circuits. Synthesis results of some of these circuits have been presented here.