A FRAMEWORK FOR STRUCTURED DESIGN OF DIGITAL SYSTEMS IN A CAD ENVIRONMENT

by

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TO MY PARENTS

CERTIFICATE

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ABSTRACT

Computer Aided Design techniques are essential to cope up with the problems arising out of the need to achieve short design cycle times for complex digital systems and due to an increase in emphasis on correctness of a design. A conceptual framework in which a design may be conceived and communicated to a computer forms the basis of these techniques. In this thesis, a language RACHNA and associated conceptual model are presented, constituting the necessary framework for digital system design. It supports a structured design approach by permitting a design to be evolved in a top down manner, expressing a subsystem as a well defined composition of smaller sub-subsystem as a well defined composition of smaller subsystems. With this structured design approach, it is easy to establish correctness of a design.

The conceptual framework which has been presented includes models for basic entities like data carriers, operators, expressions and various forms of descriptions for systems synthesized from these. RACHNA is introduced using these definitions. It is primarily for describing behaviour of a digital system in a procedural manner, but also permits a designer to contribute to structural details. Various hardware features like parallelism, pipelining, asynchronism, timing, and

delays can be described conveniently. A directed graph representation called R-Net, derived from Petri-Net, has been presented for RACHNA. This is a concise form of representation for simulation and logic translation. It is also helpful in understanding the language semantics. Because of the structured nature of RACHNA constructs, R-Nets are 'live' and 'safe'.

In the context of RACHNA, major design activities, namely, design evaluation and logic translation or synthesis are discussed, demonstrating the feasibility of the approach. A simulator has been implemented through which a design can be evaluated and various design alternatives can be explored. Techniques which can be used in a simulator for detecting design inconsistencies have been discussed. This provides very useful information to a designer for debugging a design. Procedures for obtaining a detailed structural form of description for a given behavioural design are discussed. This could subsequently be used for component level synthesis.

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