Abstract

This thesis presents a framework for computer aided design of microprocessor based systems. Such designs involve the *codesign* of the target system's hardware as well as the application software and the system software. A novel two layer architecture of the design system has been presented, where the first layer (christened MICKEY) is a design system which utilizes hybrid representation (rules as well as procedures) of the application specific knowledge, to synthesize both the hardware and the software. However, knowledge being seldom complete, MICKEY may fail to deliver a solution, if knowledge about a specific implementation is not present in the knowledge base. In order to alleviate this traditional problem of first generation knowledge based systems, MICKEY is coupled to a second system (called MINNIE). MINNIE is capable of performing behavioral mapping between the design functions and available devices, to return an implementation for a design subgoal (function), to MICKEY. Thus, resilience is imparted to the overall design system.

A statechart based language, SpeX, has been presented for acquiring the specification of the target system. MICKEY processes the input specification, through a number of phases, such as algorithm design (where the CDFG is derived), architecture design (where the tasks of hardware software partitioning, allocation and scheduling are performed), interface design (where addresses are allocated to the devices, and device drivers are synthesized), software design and circuit design. The performance of the synthesized design is then validated through cosimulation. The issues involved with each of the phases has been identified and addressed. An integrated formulation of hardware software partitioning, allocation and scheduling has been provided as a CLP (Consistent Labeling Problem). A number of heuristics have been experimentally evaluated to solve the CLP, and the one showing best performance has been applied. A number of problems of industrial relevance have been solved with MICKEY.

For the behavioral mapping task of MINNIE, a new representation scheme, Composite Finite State Machine (CFSM), has been proposed. This scheme considerably reduces the number of states for describing the behavior of a function as well as that of a device, and thus facilitates the mapping process. Algorithms for behavioral mapping are also proposed. The efficacy of MINNIE has been demonstrated by solving several real life interfacing problems.

Keywords: Hardware Software Codesign, Microprocessor based Systems, Knowledge based Systems, Computer Aided Design, Behavior Modeling, Behavior Equivalence.