SYSTEM MEDIS FOR DESIGN OF IC VLSI

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KEY WORDS: integrated circuit, VLSI, circuit design, CAD, MEDIS

ABSTRACT: MEDIS (MicroElectronic Design Integrated System) is an original system for an automated design of integrated circuits, which is being developed in TESLA VUST. The software base of the system is created by a core to which are connected application programs called tools. The core enables entire contact of tools to the user and to the database with description of ICs. Relative independence of a tool on hardware is achieved by core functions. Tools communicate with a user by means of standard interfaces which are delivered in a form of extended function libraries. Using special tools it is possible to design an IC by various design methods. MEDIS is an open system which can be extended by other application tools to make it possible to use the system in various application regions in addition to design of ICs.

SISTEM MEDIS ZA NAČRTOVANJE VLSI INTEGRIRANIH VEZIJ

KLJUČNE BESEDE: Integrirano vezje, VLSI, načrtovanje vezij, CAD, MEDIS

POVZETEK: MEDIS (Microelectronic Design Integrated System) je originalen sistem za avtomatsko načrtovanje integriranih vezij, ki je bil razvit v TESLA VUST. Programska osnova sistema je zgrajena na jedru, na katerega so povezani uporabniški programi - orodja. Jedro omogoča popoln stik uporabnika z orodji in podatkovno bazo z opisom integriranega vezja. Funkcije jedr atudi omogočajo relativno neodvisnost orodij od uporabljene strojne opreme. Uporabnik komunicira z orodji s pomočjo standardnih vmesnikov, ki so izdelani v obliki razširjenih funkcijskih knjižnic. S pomočjo posebnih orodij je mogoče integrirano vezje načrtati z uporabo več načrtovalskih metod. MEDIS je odprt sistem, ki ga lahko razširimo z drugimi uporabniškimi orodji in ga uporabimo na drugih področjih poleg načrtovanja integriranih vezij.

INTRODUCTION

The present design of an integrated circuit consists basically of two main stages. At first it is the design of a circuit structure, i.e. logical structure synthesis, and at second the design of integrated circuit masks for technological realisation of the circuit. The research institute TESLA VUST has a long tradition in development of software programs supporting the design of integrated circuits, programs varying in purposes and complexity, for different hardware design systems and using various access methods to a problem. Many very useful software moduls have been developed and some of them are still in use in different stages of IC's design. The disadvantage of this state-of-the-art in programming is obvious.

The increasing complexity of integrated circuits and the demand for more effective and rational design procedure made it necessary to create complex design system for IC VLSI with unified and simplified access to all design software modules and with common database describing an IC.

To be independent on import and simultaneously to take advantage of the experienced software experts in TESLA VUST it was decided to develope an advanced design system MEDIS - MicroElectronic Design Integrated System - based on the present demands and open for necessary extension according to the future needs[1, 2, 3]. MEDIS is being implemented on 32-bit computers SM 52/12 (analog of DEC VAX 11 family) with extended internal and external memories, graphical stations, terminals and other peripherals and on personal computer analog IBM PC/AT.

MEDIS ARCHITECTURE

MEDIS is being built as a set of software moduls developed for a complex design of integrated circuits using different design methods. From the user's point of view the system behaves as a design environment equipped with various tools for working in all design stages of an IC and containing all necessary information describing the IC.

The philosophy of MEDIS structure is shown in Fig. 1. The MEDIS is an open modular system which consists basically of a core and of application software modules

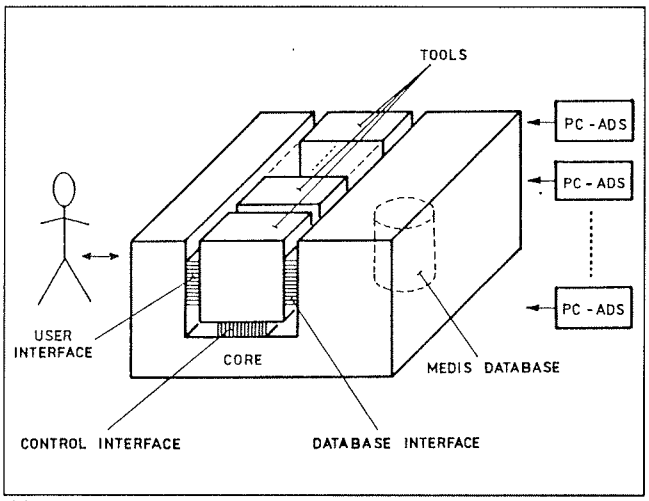

Fig. 1: MEDIS architecture

called tools. The core is the main part of the software system MEDIS which assures all contacts to a user, deals with data in database MDB (MEDIS DataBase), etc. Specialized tools are connected to the core using standard interfaces, which are the most important modules of the core. The main goal of this architecture is to create in the core a unified software environment for all tools from arbitrary application fields. All tools are therefore treated by the user in a similar way.

LOGICAL STATION

The core function can be best shown on a function of a logical station (see Fig. 2). The logical station is a set of hardware means (mostly a complete graphical station) and software means (modules) working in a given moment for one user.There can be several logical stations working simultaneously on MEDIS. For the user the work on a logical station representates the work on the entire system MEDIS; therefore it will be explained.
Modul DISP assures communication between all modules included into a logical station, whereas conversation modul CONV exchanges communication with a user including graphical input/output, control of a display and other peripherals. One or more activated tools communicate with other modules by means of standard interfaces. The control interface MEDIF gives commands and receivers reports about tool activities, the database interface DBIF manipulates with data in MDB and LOPIF + LOPAN are graphic interfaces serving the user to control all graphic operations.

MDB is an integrated part of the core. It is a specialized database system created for deposition of hierarchically structured information about an IC. It enables to store various representations of the IC as the function description, the logic diagram, masks, etc., including mutual connections between these data. MDB is also built up as an open system.

TOOLS OF THE DESIGN SYSTEM

Into the core are being successively implemented all the necessary tools for design of ICs. We mention only the main groups in global.

Specialized graphical editors are the basic tools of the design system. There will be editors for function description, for schematic diagrams and for masks there. Simulators on every circuit's design level have been developed; functional, electrical, logic and mixed simulators are available. In the institute are also being developed simulators of technological procedures of ICs which help to optimize the technology. Verification programs, for instance on masks level, checks the proper geometrical relations of masks and doing logic operations between masks levels are able to recognize the electrical and logic elements on the chip and therefore to extract the electrical and logic circuit [4]. Tools for automated design of custom and semicustom integrated circuits using various design methods are also being implemented into the system. So are preprocessors and postprocessors for data transfer between MEDIS and its surrouding (e.g. to masks generator). For connection to other design systems it will be used the standards CIF and EDIF.

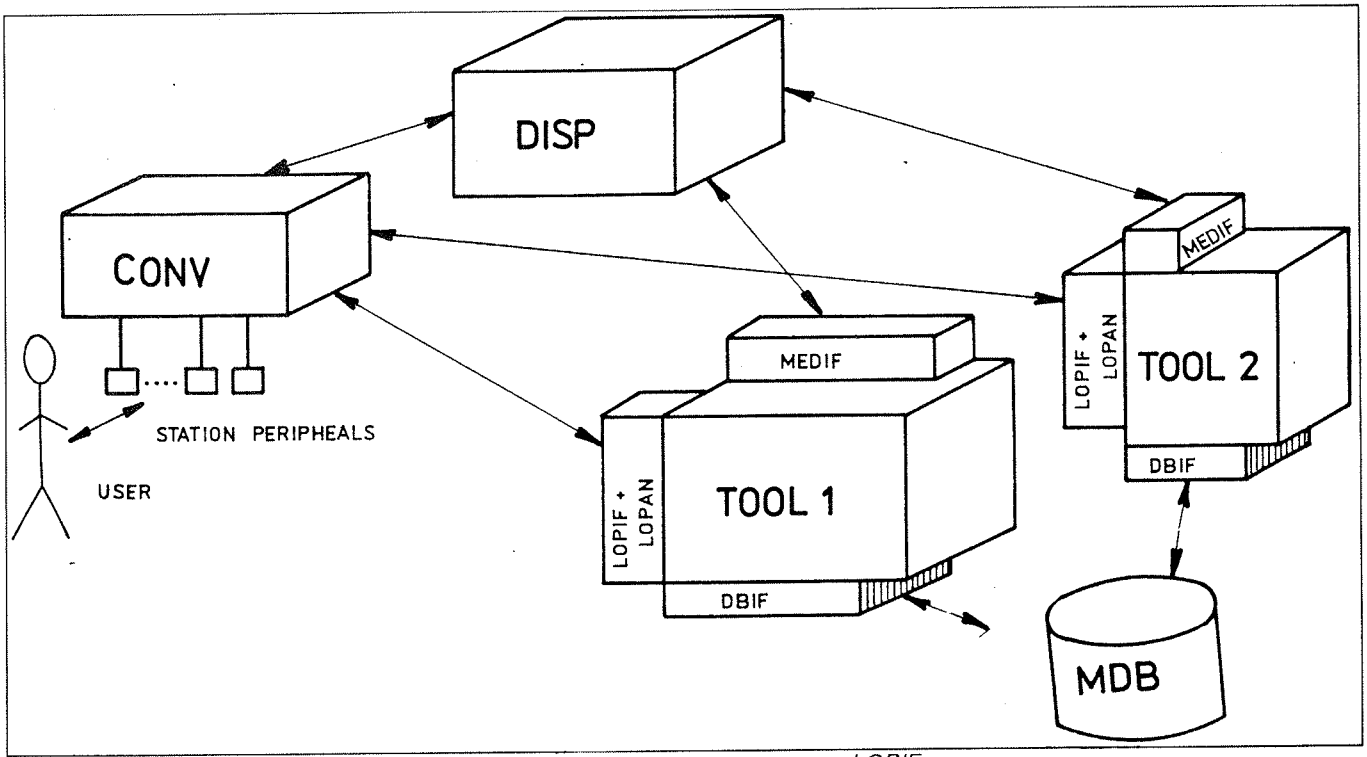

Fig. 2: *Logical station structure*
DISP - dispatcher modul
CONV - conversation modul
MDB - MEDIS database
LOPIF
LOPAN - user interfaces
MEDIF - control interfaces
DBIF - database interface

Other Specialized tools are being implemented, e. g. a subsystem for documentation storing and updating, for authorization of MEDIS users, ICs information subsystem etc.

PERSONAL COMPUTER-AIDED DESIGN SYSTEMS (PC-ADS)

PC-ADS is a special subsystem of MEDIS implemented on IBM/AT compatible personale computers and enabling a desing of custom integrated circuits. PC-ADS is an appropriate tool developed mostly for system designers to project and verify a logic diagram suitable for automatic layout design consistent with the actual integrated circuit technology [5].

Fig. 3 shows the program modules of the PC-ADS and their interconnection [6],[7]. The modules in the broken line boundary - USIN (USer's INterface) - support the logic diagram development and its verefication by simulation. This particular part of the PC-ADS is determined for the broad exploatation among the system designers. Remaining modules support the automatic layout design, compute the real interconnection capacitances and provide the simulator SIMUL with more accurate data modifying the delay times in the circuit diagram. Two design styles have been implement in the PC-ADS now,API - based on standard cells and SIPR - based on arbitrarilysized rectangular blocks. The third one, STICK - a design style based on stick diagrams, is being developed.

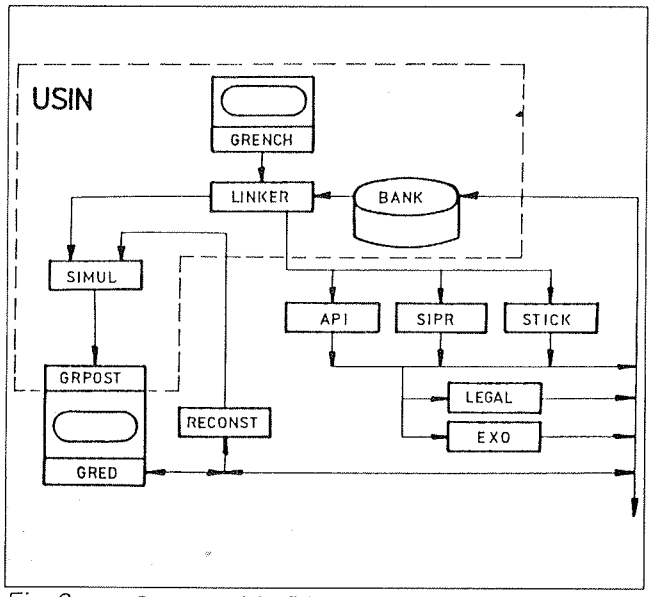

Fig. 3: *Structure of the PS-ADS*
USIN - user's interface
BANK - subset of MEDIS DataBase containing the library of blocks
GRESCH - graphical editor, e.g. OrCAD
LINKER - modul connecting GRESCH with BANK
API - modul for placement/routing in the standard cells based design style
SIPR - modul for placement/routing of the arbitrarilly sized rectangular blocks design style
STICK - modul for the stick diagram based design style
LEGAL - modul defining boundaries of created blocks
EXO - generator of exoattributes of blocks defined by LEGAL
GRPOST - graphical postprocessor for visualisation of the simulation results
GRED - graphical editor for interactive editing of placement/routing

The BANK contains the atributes of library blocks. They are defined parametrically by means of data defining the technology. The library manager who ranks among mask designers is responsible for distribution and validity of the data in the BANK ensuring this way the compatibility of the designed logic diagram with the available technology. The same data are of course in the MEDIS database, because the BANK is a data subset of data stored in MDB.

PC-ADS is not an autonomous design system, it is considered as an intelligent terminal of an integrated circuits design center with MEDIS.

CONCLUSION

The architecture of MEDIS makes it possible to work separately on further development of the core and of specialized tools. We can consider the empty core as an analogy to an empty expert system. The final task is to accomplish it as a universal software system independent on hardware means and open to further extention to other application fields, even to those having with microelectronics little in common. To achieve this goal it is necessary to implement new application tools into the unified core environment and simultaneously to define the way how to store the data for this particular application into MDB.

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