EduCAD: an Efficient, Flexible and Easily Revisable Physical Design Tool for Educational Purposes

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Abstract
Education of physical design algorithms is very problematic due to the sophisticated structure of physical design tools and algorithms. In this article, we presented an Educational VLSI-CAD tool (EduCAD) that provides a simple and easy to change framework to learn and evaluate the physical design algorithms for educational and research applications. Utilizing the EduCAD for the graduate course "VLSI-CAD algorithms" in Shahid Beheshti University shows that the expertise of students on physical design algorithms has improved considerably.

Keywords
Computer aided design, Education, Physical design.

1. Introduction

Physical design is an important part of electronic design automation (EDA) in which final layout of the chip is constructed. This stage is one of the most complicated steps of the design flow since many of physical and geometric parameters of chip fabrication such as process variation and crosstalk noise should be considered as well.
Complex structure of the physical design has made some problems in educational and research centers which train the backend engineers/researchers. The main problem is that analyzing, probing and updating the current VLSI CAD tools is not possible for the students because these tools are very complex and their internal algorithms and variables are not accessible.
We developed an educational physical design tool which provides a simple and easy to change layout generation flow for standard technologies and real design circuits. Educational VLSI-CAD Tool (EduCAD) provides a simple, analyzable and updatable environment for the students with efficient and simple GUI that shows demonstrative views of the design.

2. Educational VLSI-CAD Tool (EduCAD)

EduCAD is an educational tool for standard cell physical design. It consists of input syntax analyzers, placement and routing engines, statistical timing analyzer, and Graphical User interface. EduCAD graphical user interfaces provides user-friendly and simple interface for students to make a desirable view on circuit at various levels of physical design. Global structure of EduCAD is as shown in Figure 1. In the rest of this article, main features of EduCAD are described.

Flexibility: a dozen of tools and algorithms are required at the back-end level of EDA to complete the layout of a design. Heterogeneity of tools and algorithms forces the EDA developers to provide flexible environments in which algorithms can be easily updated or new modules can be simply integrated. EduCAD provides a felxible mechanism to integrate the tools and connects them via an in-memory physical design database.

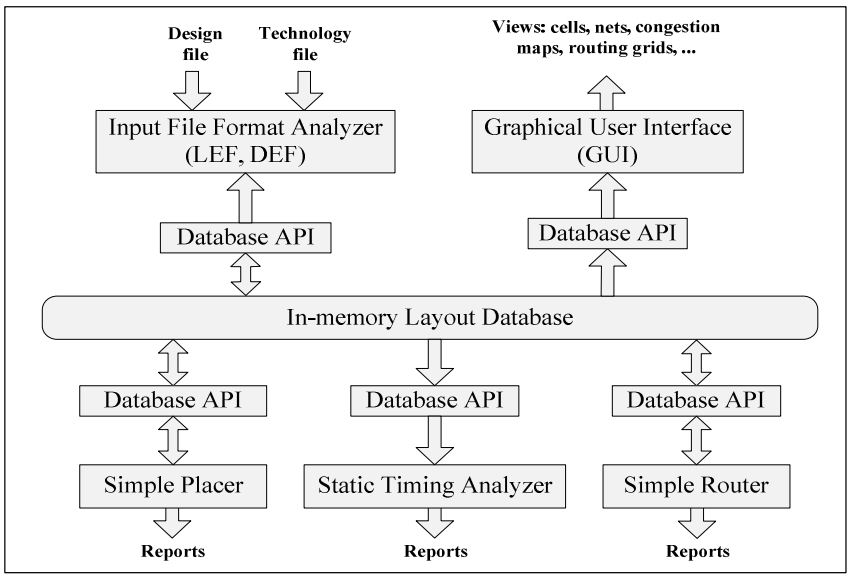

Figure 1: Block diagram of EduCAD

User friendly and easy-to-change GUI: Graphical user interface is an effective part of a physical design which makes the understandable and informative views on the design, especially for educational purposes. However, design of graphical user interface is not simple and requires considerable graphical design expertise. We developed a simple and user-friendly interface with different views such as cells, nets, routing grids, congestion map and some other information of design in physical layer in EduCAD that can be revised by the students to generate any new graphical capture.
Graphical Qt library [1] is an industrial standard library to implement the GUI in EDA tools which is supported by Linux, Solaris and Windows. Graphical user interface of EduCAD has been developed based on Qt library to use capabilities of Qt and also can be ported to other operating systems.

In-memory Database: EduCAD uses a centralized database for all levels of physical design information. It is an object-oriented database that covers all physical design objects. Tools can exploit the results of the previous engines by making query from the central database by calling database Application Programming Interface (API) functions. Moreover, the EduCAD database has been designed as an in-memory database to provide more speed, especially for large circuits.

Easy-to-change Algorithms: as mentioned before, EduCAD has been developed for educational applications. Therefore, it has not been equipped to cutting-edge physical design algorithms. We developed a simple prototype of placer and router in the tool which consists of the basic functions such as reading the design, computing total wire length and creating basic data structure and performing placement and routing. Students can improve it and develop any other physical design engines. Each simple engine has three phases:

- Reading design from the database of EduCAD.
- Performing a simple physical design algorithm on the loaded design.
- Writing the result of physical design algorithm into the central database.

In this structure, GUI can be used between or after running the engines to view information stored in the central database.

Standard input data formats: EduCAD supports standard input and output file formats. These standards are Library Exchange Format (LEF) and Design Exchange Format (DEF) for technology and design information, respectively. By using the standard formats, any intermediate information of the design can be transported from EduCAD to other industrial EDA tools and vice versa.

Linux-based platform: Portability, simplicity and performance of Linux has made it as an emerging operating system for new EDA tools [2]. EduCAD has been designed and implemented based on Linux operating system.

3. References

[1] Cross-platform application and UI framework, Available on http://www.qt.com, 2011.
[2] Daniel Payne, "Tanner EDA tools now on Linux, Available on http://www.chipdesignmag.com/payne/tanner-eda-tools, 2010.