

Robei 集成电路实战



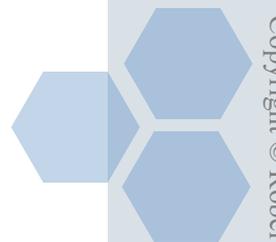
Robei-Vivado联合设计
流水灯设计





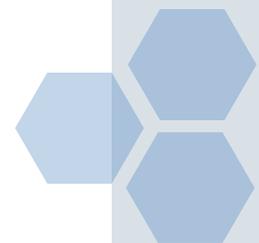
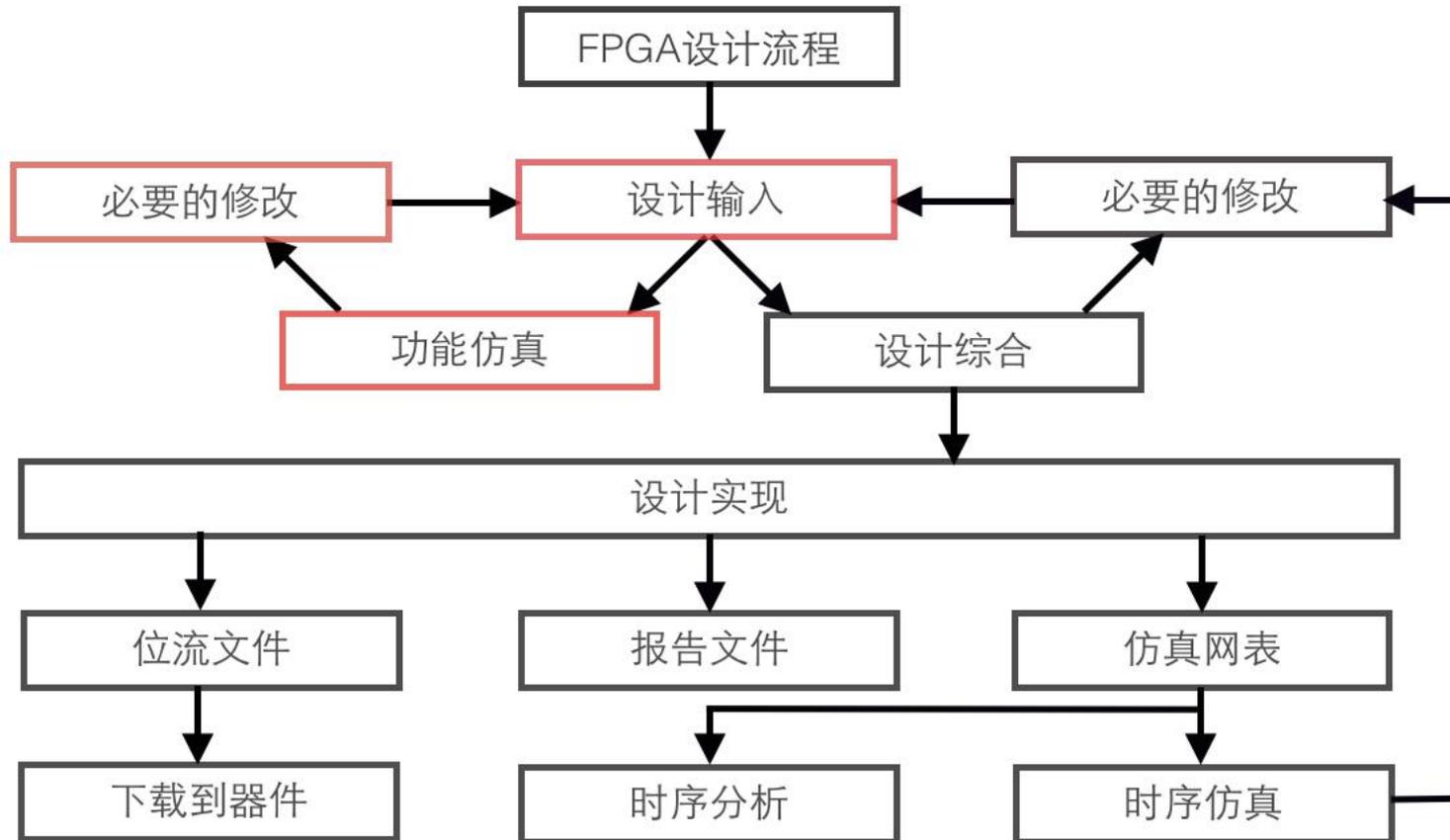
Robei实验：流水灯设计

- 1 **FPGA设计流程**
- 2 **综合-实现-比特流生成**
- 3 **实验设计：前端**
- 4 **实验设计：后端**





Robei实验：流水灯设计





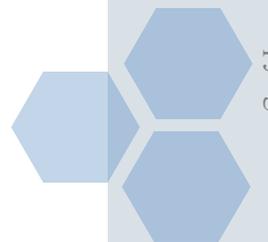
Robei实验：流水灯设计

综合（Synthesis）：

综合是为了完成从代码到门级电路的转换，也是把我们的设计转换为FPGA可以读懂的配置文件的第一个步骤。

常用的综合工具：

- Design Compiler
- Xilinx ISE
- Altera Quartus II
- Xilinx Vivado





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实现（Implementation）：

结合约束文件，把综合得到的逻辑门级电路制作成为可以在目标**FPGA**上运行的实际电路。

转换→映射→布局布线→时序提取→配置

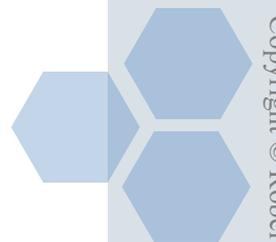
把多个设计源文件转换合并为一个设计库文件

把逻辑门级电路中的元件映射为物理元素

将映射后的物理元素分配到**FPGA**结构中

产生反标文件，供给后续时序仿真使用

产生**FPGA**配置的位流文件



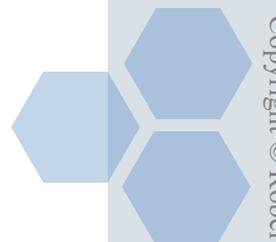


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位流（比特流）（**BitStream**）：

是一个连续的位序列，实现软件与器件间的直接通讯。

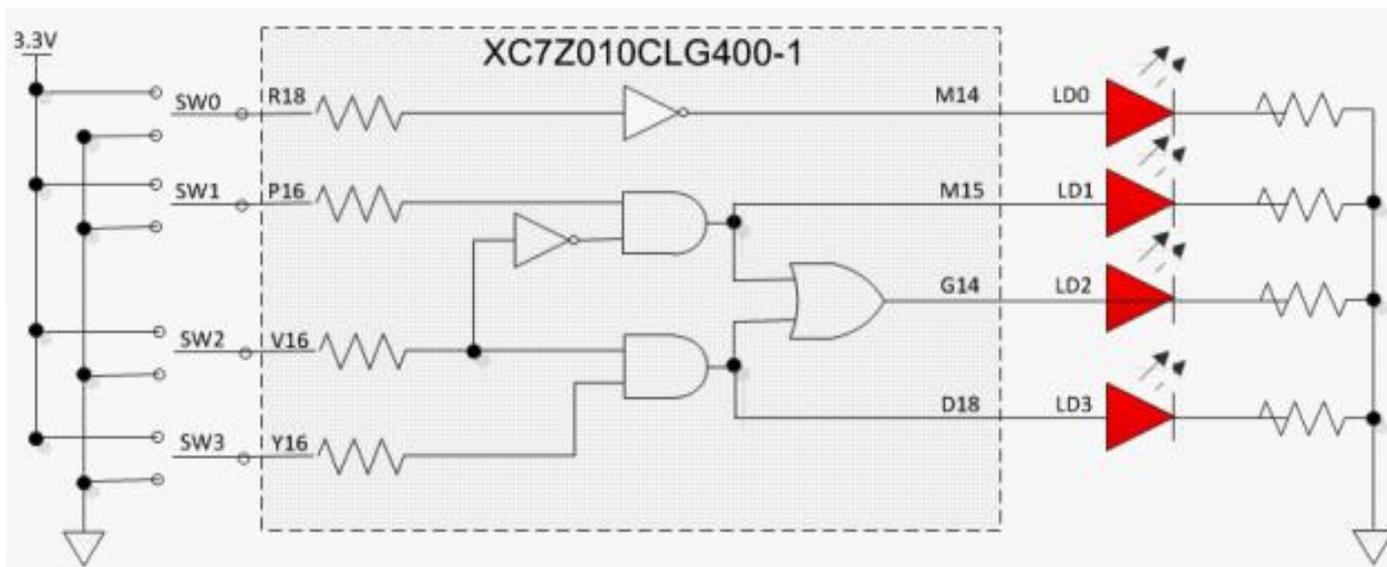
位流文件成功生成后，即可将其下载到**FPGA**中来实现设计的功能。



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实验设计：前端

设计包括直接连接到对应的输出LED的一些输入。其它的输入在进行一些逻辑操作之后输出到剩余的LED。



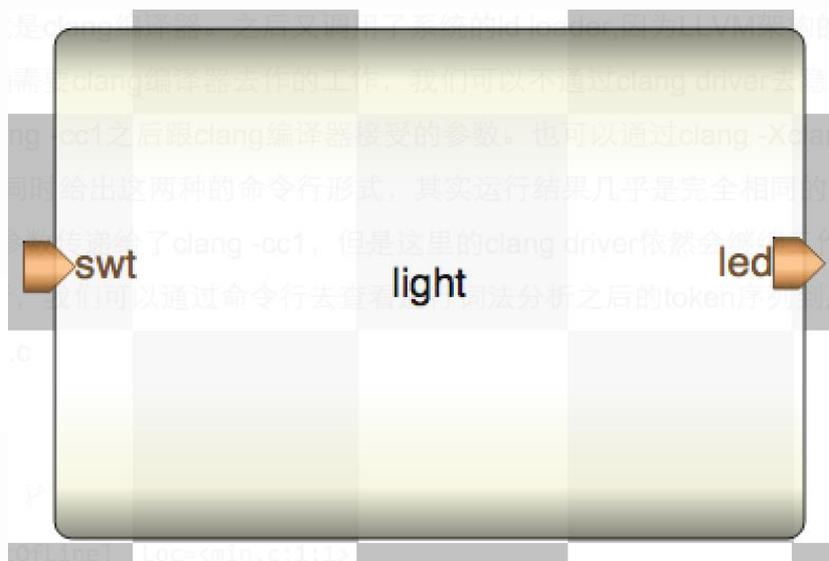


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light Datasheet

Ports:

Name	Inout	Data Type	Datasize	Function
swt	input	wire	4	
led	output	wire	4	





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```
light
12 assign led[0] = ~swt[0];
13 assign led[1] = swt[1] & ~swt[2];
14 assign led[2] = (swt[1] & ~swt[2]) | (swt[2] & swt[3]);
15 assign led[3] = swt[2] & swt[3];
16
```

```
1
2 module lighter(swt,led);
3
4 //---Ports decleration---
5 input [3:0] swt;
6 output [3:0] led;
7
8 wire [3:0] swt;
9 wire [3:0] led;
10
11 //----Code starts here-----
12 assign led[0] = ~swt[0];
13 assign led[1] = swt[1] & ~swt[2];
14 assign led[2] = (swt[1] & ~swt[2]) | (swt[2] & swt[3]);
15 assign led[3] = swt[2] & swt[3];
16 endmodule //lighter
17
```

```
assign led[0] = ~swt[0];
assign led[1] = swt[1] & ~swt[2];
assign led[2] = (swt[1] & ~swt[2]) | (swt[2] & swt[3]);
assign led[3] = swt[2] & swt[3];
```

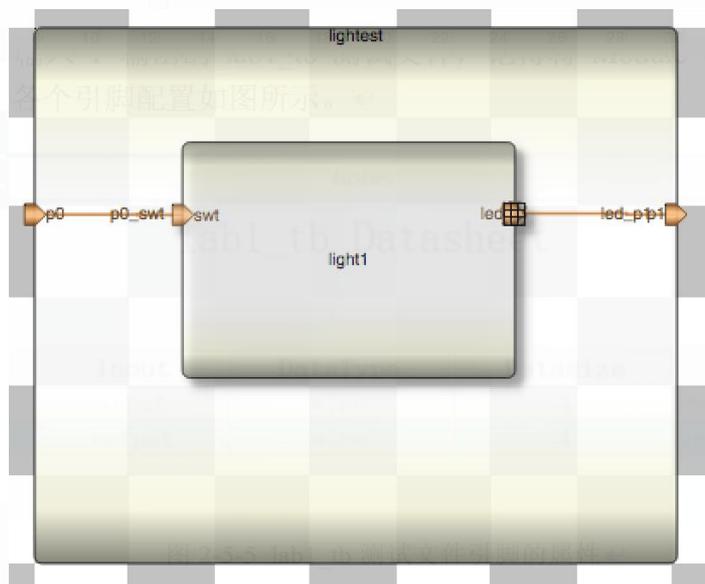




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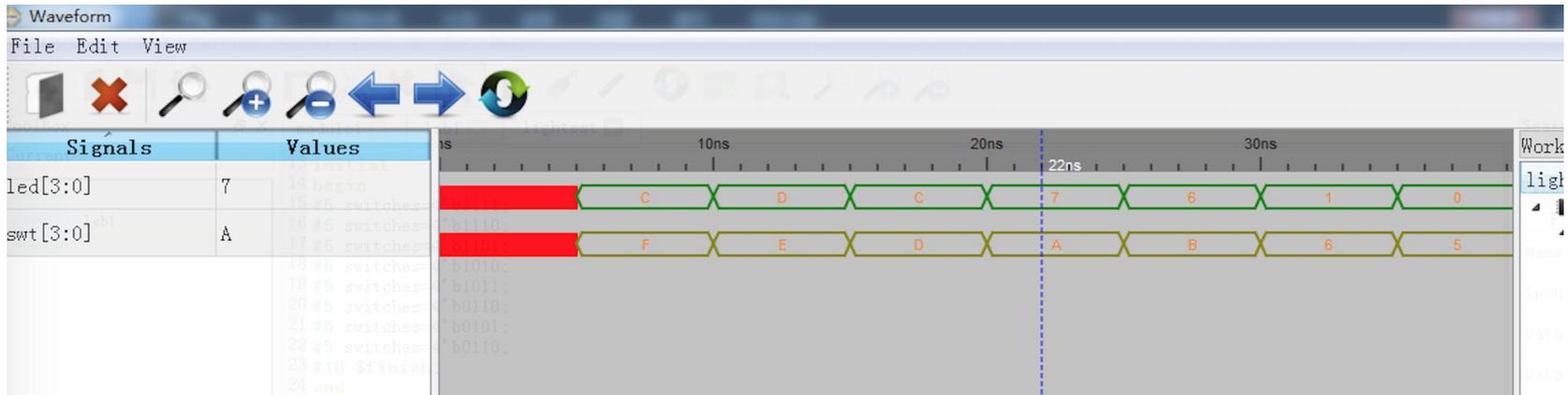
测试模块设计：

```
lightest
11 initial
12 begin
13 #5 switches=4'b1111;
14 #5 switches=4'b1110;
15 #5 switches=4'b1101;
16 #5 switches=4'b1010;
17 #5 switches=4'b1011;
18 #5 switches=4'b0110;
19 #5 switches=4'b0101;
20 #5 switches=4'b0110;
21 #10 $finish;
22 end
23
```





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SWT[3:0]=A led[3:0]=7
SWT[3]=1 led[3]=0
SWT[2]=0 led[2]=1
SWT[1]=1 led[1]=1
SWT[0]=0 led[0]=1

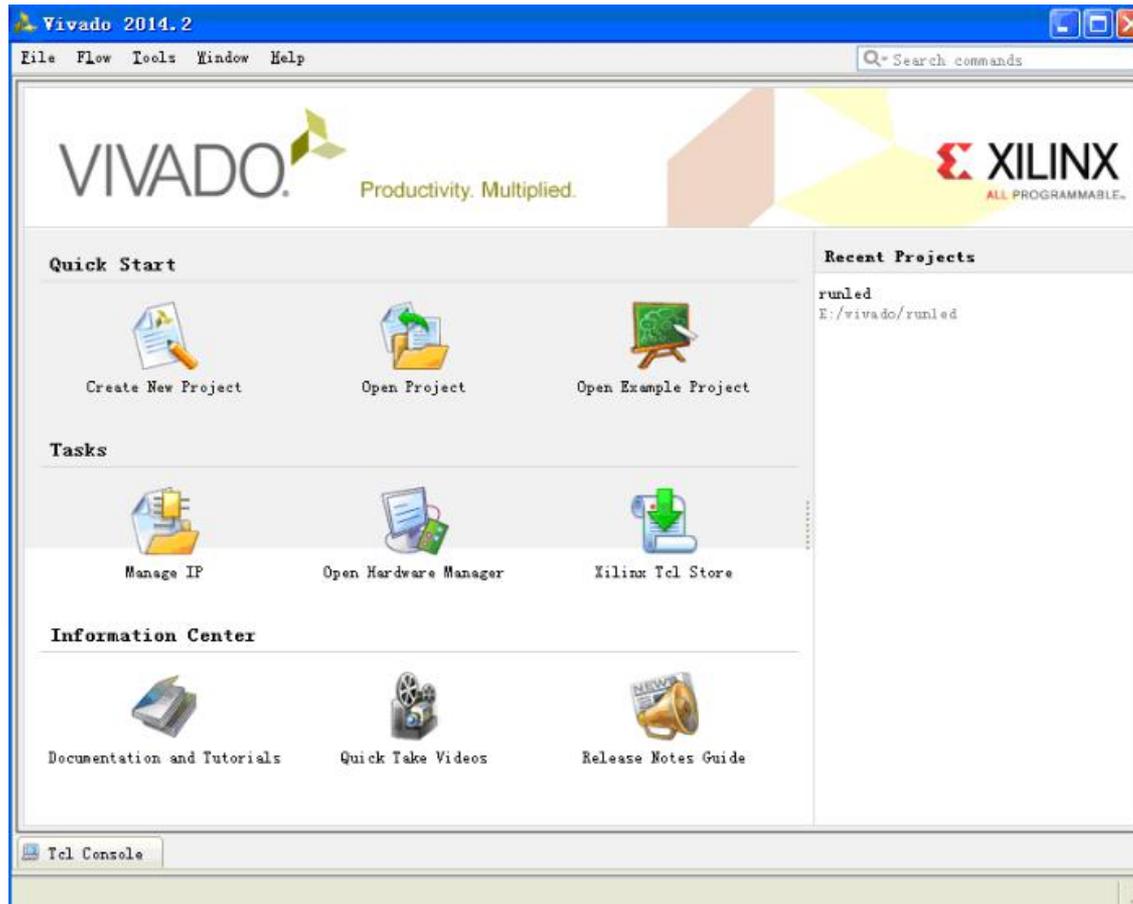
assign led[0] = ~swt[0];
assign led[1] = swt[1] & ~swt[2];
assign led[2] = (swt[1] & ~swt[2]) | (swt[2] & swt[3]);
assign led[3] = swt[2] & swt[3];





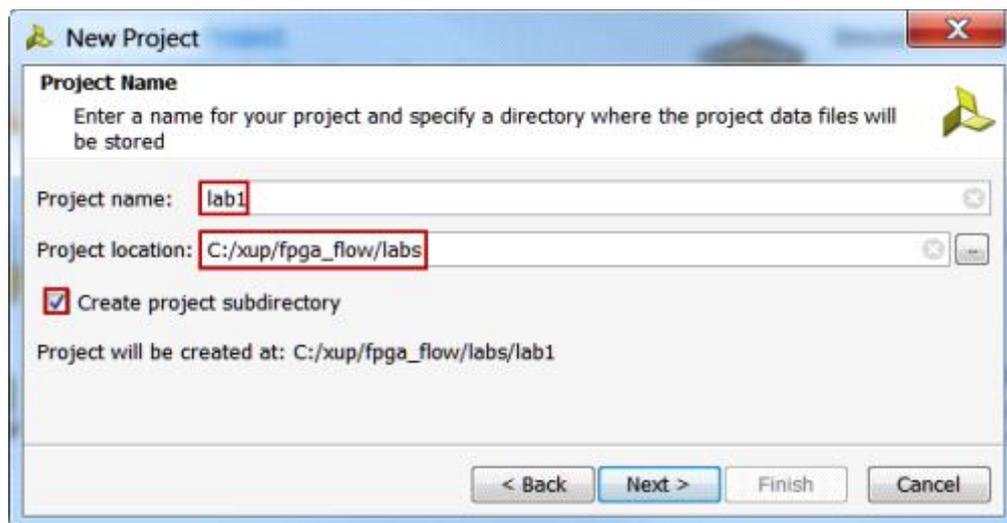
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实验设计：后端



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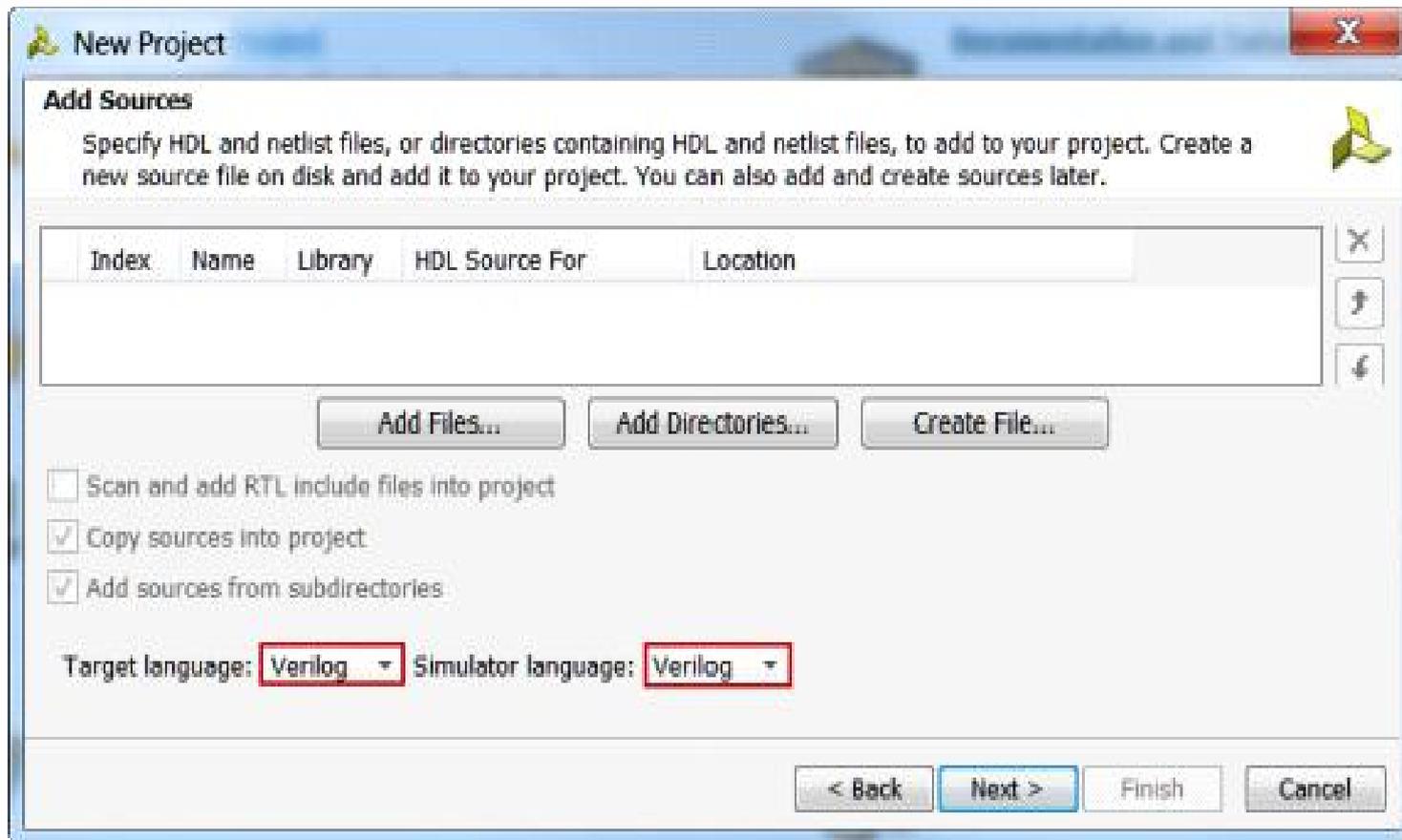
单击创建新项目 **Create New Project** 启动向导。
你将看到创建一个新的Vivado项目对话框。
单击**Next**;



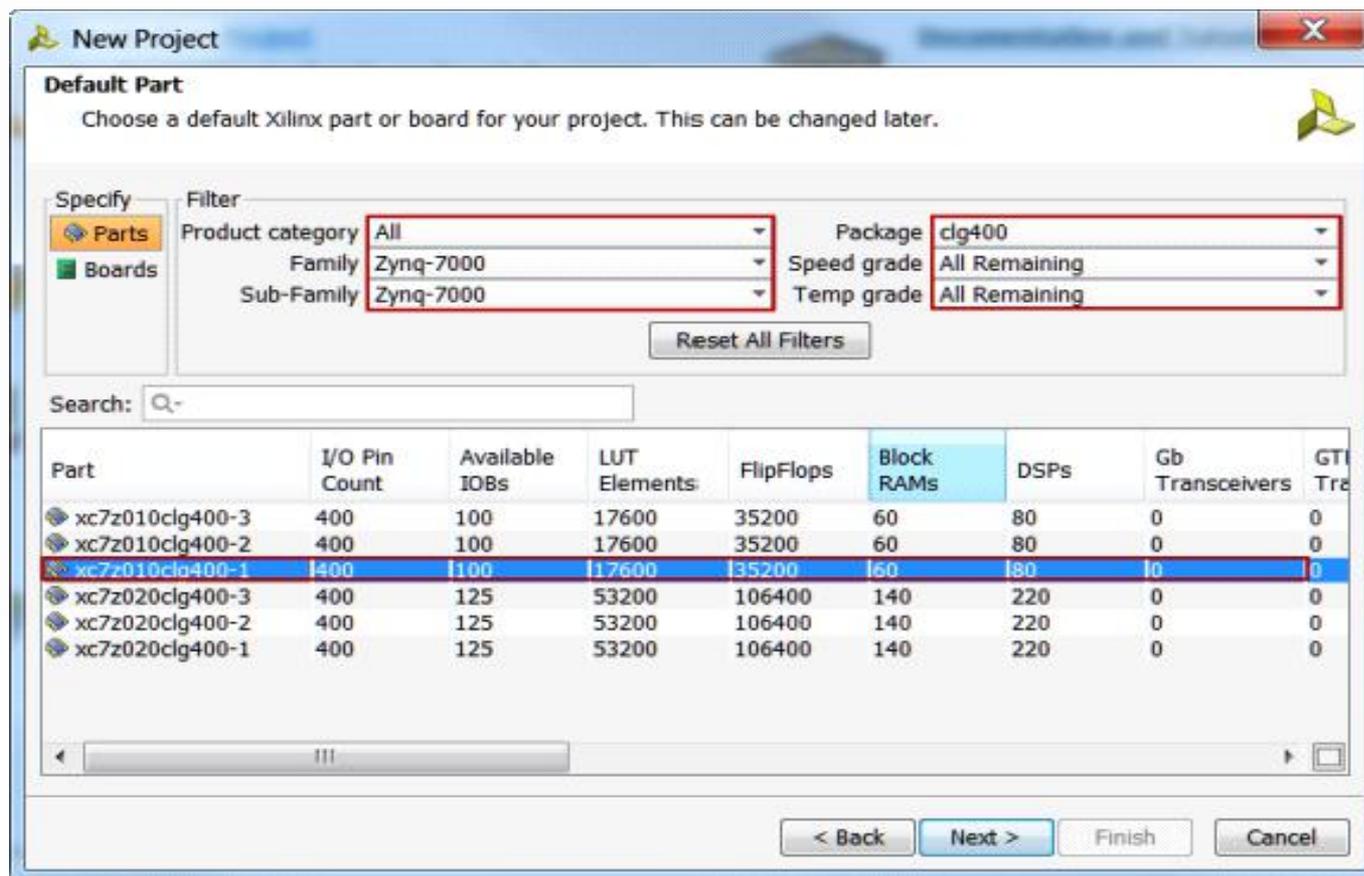


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点击Add Files添加设计好的.v文件：



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Project Manager - lab1

Sources

- Design Sources (1)
 - lab1 (lab1.v)
- Constraints (1)
- Simulation Sources (1)

Hierarchy | Libraries | Compile Order

Sources | Templates

Sources

- Design Sources (1)
 - lab1 (lab1.v)
- Constraints (1)
 - constrs_1
 - lab1.xdc
- Simulation Sources (1)
 - sim_1 (1)
 - lab1 (lab1.v)

Hierarchy | Libraries | Compile Order

Sources | RTL Netlist | Device Con..





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```
# ZYBO xdc
# LED [3:0]
#####
# On-board led      #
#####

set_property PACKAGE_PIN M14 [get_ports led[0]]
set_property IOSTANDARD LVCMOS33 [get_ports led[0]]

set_property PACKAGE_PIN M15 [get_ports led[1]]
set_property IOSTANDARD LVCMOS33 [get_ports led[1]]

set_property PACKAGE_PIN G14 [get_ports led[2]]
set_property IOSTANDARD LVCMOS33 [get_ports led[2]]

set_property PACKAGE_PIN D18 [get_ports led[3]]
set_property IOSTANDARD LVCMOS33 [get_ports led[3]]
```



Robei实验：流水灯设计

单击综合任务下拉菜单中的**Run Synthesis**。在综合过程将在lab1.v文件运行以及所有分层文件。

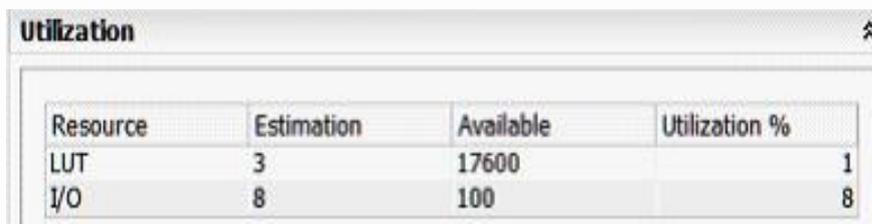
The screenshot displays the 'Project Summary' window with the following details:

- Project Settings:** Project name: lab1, Product family: Zynq-7000, Project part: xc7z010cpg400-1, Top module name: lab1.
- Synthesis:** Status: Complete (green checkmark), Messages: No errors or warnings, Part: xc7z010cpg400-1, Strategy: Vivado_Synthesis.Defaults.
- Implementation:** Status: Not started (yellow arrow), Messages: No errors or warnings, Part: xc7z010cpg400-1, Strategy: Vivado_Implementation.Defaults.
- DRC Violations:** DRC information is not available because it hasn't been run.
- Timing:** Timing information is not available because it hasn't been run.
- Utilization:** A bar chart shows LUT at 1% and I/O at 8% utilization. The x-axis is 'Estimated Utilization (%)' from 0 to 100.
- Power:** Power information is not available because it hasn't been run.

Additional annotations in red text include: 'Device, Project name, and Top module name' pointing to the project settings; 'Synthesis completed' next to the synthesis status; 'Implementation not yet started' next to the implementation status; and 'Utilization in graph mode' above the utilization chart. At the bottom, there are tabs for 'Graph' and 'Table' under the 'Post-Synthesis' section, and a note 'Select between graph and table display'.

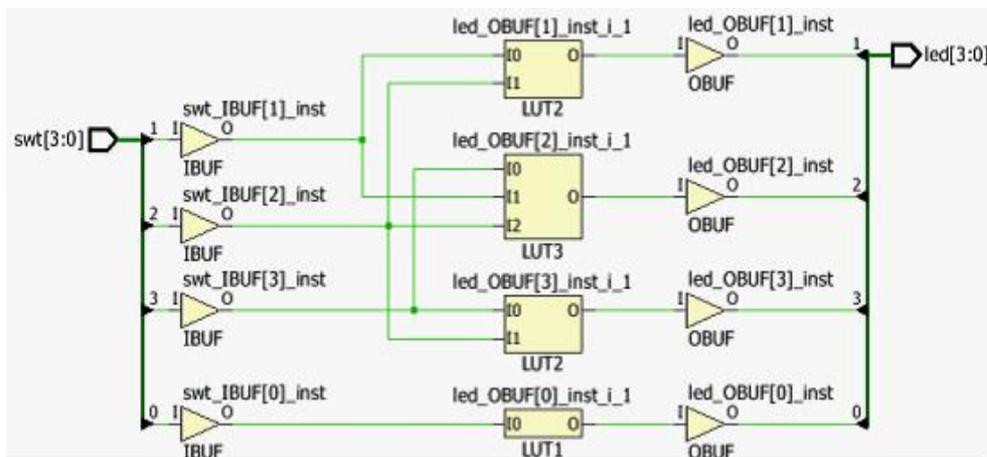
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单击项目摘要选项卡中的**Table**。请注意，估计有**3个LUT**和**8个IO**（4输入和4输出）被使用。



Resource	Estimation	Available	Utilization %
LUT	3	17600	1
I/O	8	100	8

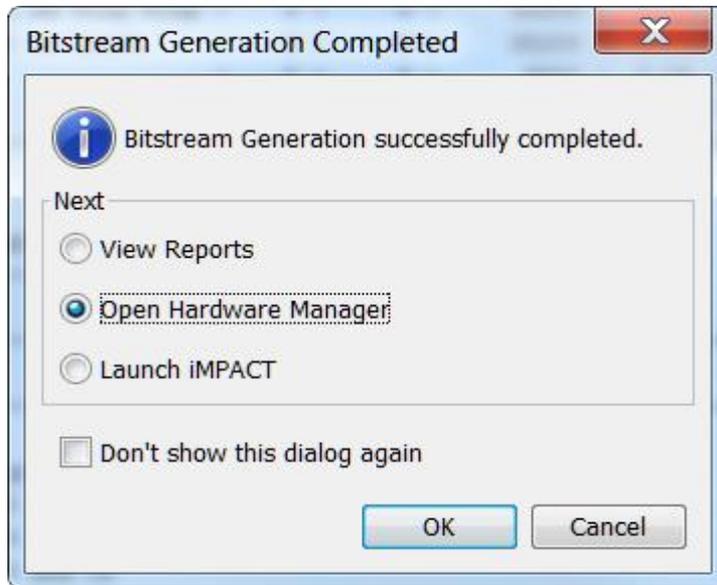
在综合下拉菜单下，单击**Schematic**，查看综合设计的示意图。





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点击 **Generate Bitstream** 生成比特流文件：



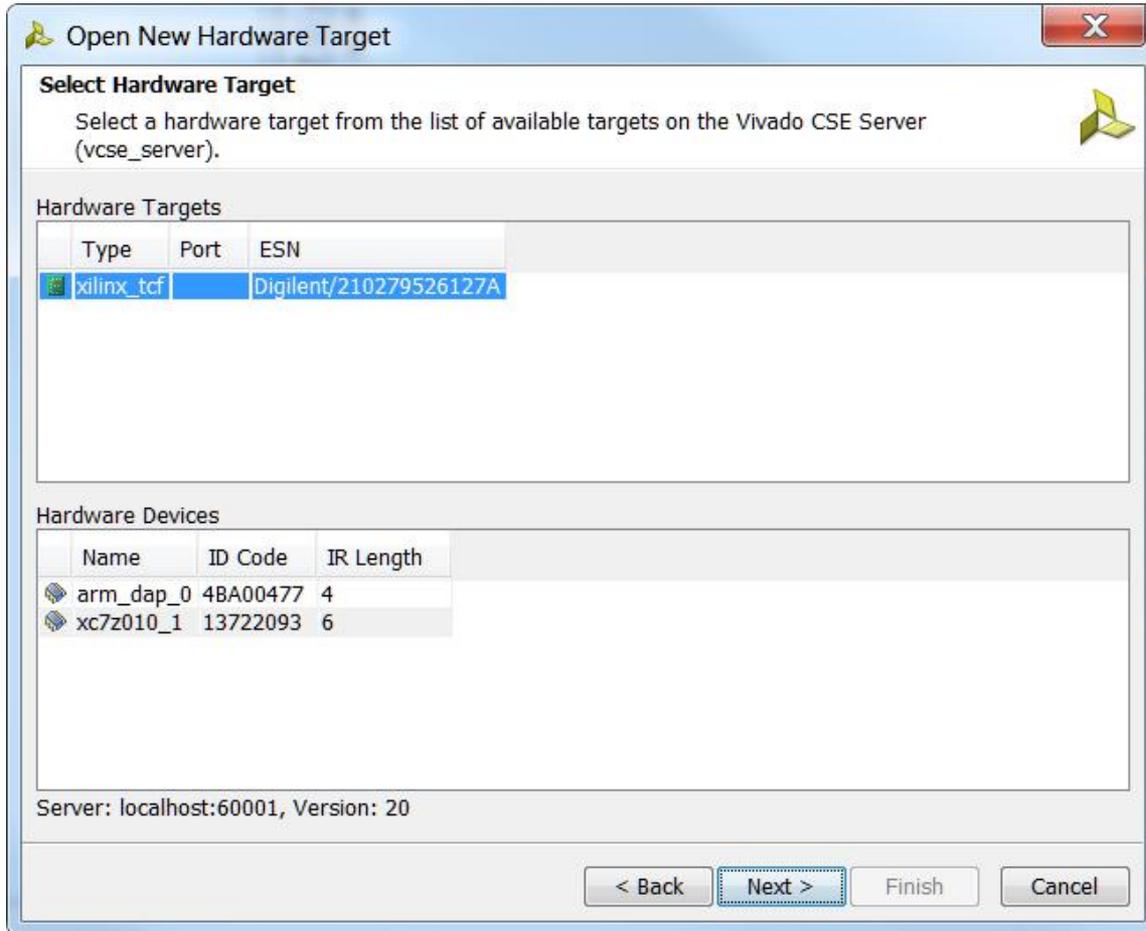
Hardware Session - unconnected

 No hardware target is open. [Open recent target](#) [Open a new hardware target](#)



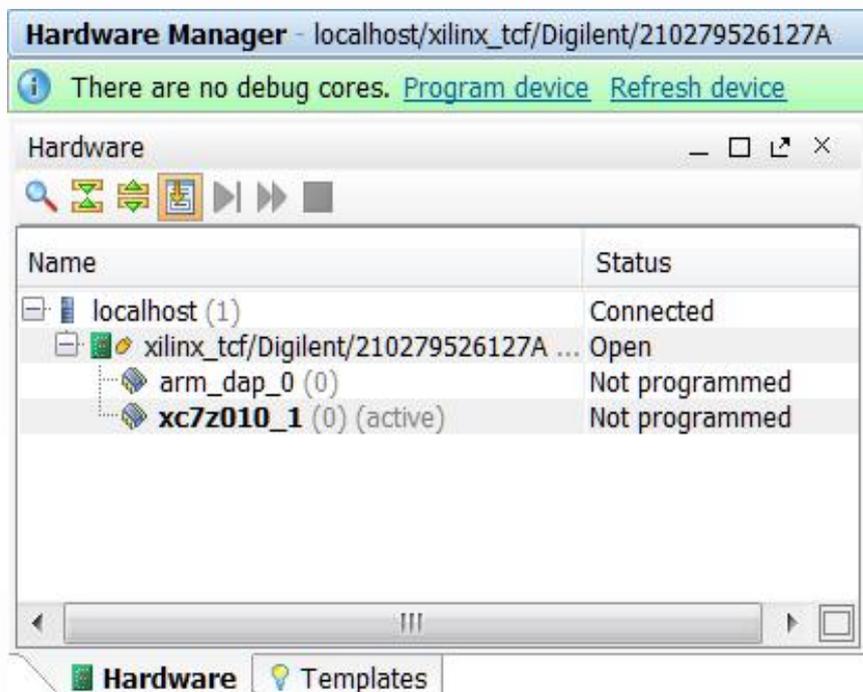


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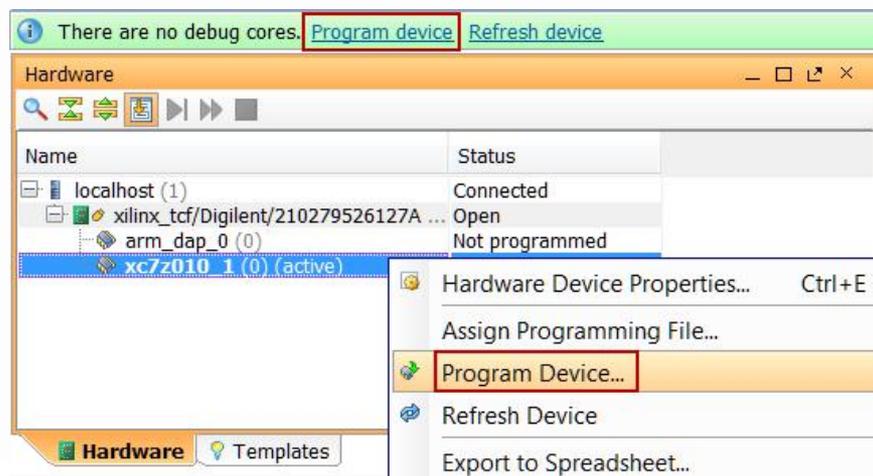
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单击两次**Next**，然后单击**Finish**。未连接硬件会话状态更改为服务器名称并且器件被高亮显示。



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在器件上单击鼠标右键，选择Program device或单击窗口上方弹出的Program device—> XC7z010_1链接到目标FPGA器件进行编程；



单击确定对FPGA进行编程。开发板上Done指示灯亮时，器件编程结束。

www.robei.com



Thank You!

