

Computer Architecture Projects

Information

- An individual/two/three students can make a team for one project.
- Each project should include the steps to reproduce, a link to github with the source code.
- Each project should be published with detailed explanation on <http://habrahabr.ru> website (it gets many hits).
- Write a minimum amount of code.
- Each project gives you an extra credit for Computer Architecture course.
- Project is not mandatory for all class only interested student can participate.
- If you have your own idea then you can discuss with instructor Muhammad Fahim
- Selection criteria will be defined after the number of interested groups for project.
- **Deadline for registration:**
- **Project duration: 8 Weeks**
- Interested candidates can write the details in: <https://goo.gl/cXwT1A>

A list of simple student projects to implement in Verilog on FPGA board.

1. Implement a design that outputs a "snake" moving over multi-digit seven-segment display.
2. Implement the Conway's Game of Life with output to LED matrix.
3. Design a circuit that divides by 3. See Hacker's Delight <http://www.silicon-russia.com/2018/02/05/hackers-delight-2ed/>
4. Design a circuit that calculates integer cube root. See Hacker's Delight.
5. Calculating Cycle Redundancy Check (CRC) using Linear Feedback Shift Register (LFSR). See Hacker's Delight.
6. Passcode recognition using state machine.

A list of simple student projects to implement in Verilog on FPGA board.

7. Stack calculator with reverse Polish notation that inputs from 16-key keyboard. See <https://store.digilentinc.com/pmod-kypd-16-button-keypad/>
8. Input from rotary encoder <https://store.digilentinc.com/pmod-enc-rotary-encoder/>
9. Input from 3-axis Accelerometer on DE10-Lite board.
10. Output interesting picture to VGA. The interface is on DE10-Lite board.
11. Input from SPI joystick <https://store.digilentinc.com/pmod-jstk2-two-axis-joystick/> . See the example of SPI module <https://github.com/yuri-panchul/2017-tomsk-novosibirsk-astana/tree/master/parts> and [examples/pmod als spi receiver](https://github.com/yuri-panchul/2017-tomsk-novosibirsk-astana/tree/master/examples/pmod_als_spi_receiver)
12. Output text from FPGA board to a console on PC using USB to UART serial console cable. See the example of UART receiver at <https://github.com/yuri-panchul/2017-tomsk-novosibirsk-astana/tree/master/parts> and [examples/uart receiver from mipsfpga](https://github.com/yuri-panchul/2017-tomsk-novosibirsk-astana/tree/master/examples/uart_receiver_from_mipsfpga)
13. Generate music. See the example at <https://github.com/yuri-panchul/2017-tomsk-novosibirsk-astana/blob/master/parts> and [examples/sound_pwm/top.v](https://github.com/yuri-panchul/2017-tomsk-novosibirsk-astana/blob/master/examples/sound_pwm/top.v)
14. Implementation of Ternary system on FPGA Board
15. Unum presentation on FPGA Board

A list of more complicated student
projects.

Project # 1

- Integrating MIPSfpga with a peripheral device or a memory controller.
- Examples of such projects:
 - <https://habrahabr.ru/post/329808/>
 - <https://habrahabr.ru/post/316770/>
 - <https://habrahabr.ru/post/325168/>
 - <https://habrahabr.ru/post/323360/>
 - <https://habrahabr.ru/post/329854/>
 - <https://habrahabr.ru/post/329852/>
 - <https://habrahabr.ru/post/321530/>
 - <https://habrahabr.ru/post/321532/>

Project # 2

- Adding instructions to MIPSfpga using CorExtend/UDI interface for creating coprocessors. These coprocessors can implement the arithmetic of intervals, fast interconnect of the mesh of cores etc.
- The examples:
- <https://habrahabr.ru/post/276205/>
- <http://zatslogic.blogspot.com/2016/01/using-mips-microaptiv-up-processor.html>

Project # 3

- Extending schoolMIPS core – for example adding load-store unit with data memory to it, making schoolMIPS pipelined, adding interrupts to it.

Project # 4

- A detailed lab describing a creative way of designing arithmetic unit – some optimized multipliers, special-case dividers, pipelined operation etc. Should use Verilog “generate” construct, be scalable, the report should include the chart of max frequency versus area versus number width.

Project # 5

- Some classic block from computer architecture – CDC 6600 scoreboard, Tomasulo unit, a very simple cache design, MESI protocol. It should demonstrate how it works with minimum amount of code

Project # 6

- Developing a game as follows:
- <https://www.youtube.com/watch?v=XHfKOE9JvBU&feature=youtu.be&app=desktop>
- Useful Resource:
- <https://github.com/yuri-panchul/2019-examples/tree/master/game>

Good Luck 😊