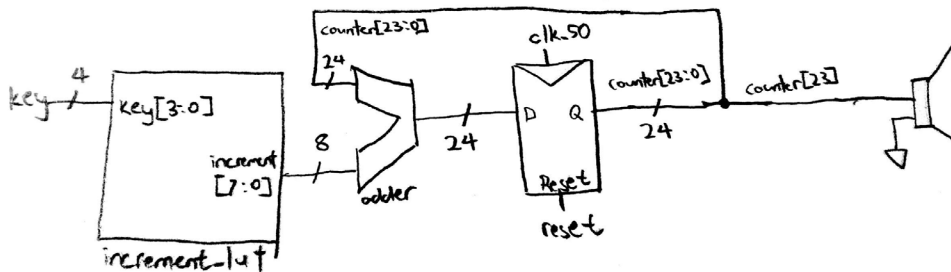


Lab 6: Music Keyboard SOLUTIONS

Digital Design and Computer Architecture: RISC-V Edition (Harris & Harris, Elsevier © 2021)

1. Please indicate how many hours you spent on this lab. This will be helpful for calibrating the workload for next time the course is taught.
2. [2] Schematic



3. [3] Behavioral SystemVerilog code

```

module lab5_sol(input  logic      clk, // 50 MHz
                input  logic      reset,
                input  logic [3:0] key,
                output logic        speaker);

    logic [23:0] count;
    logic [7:0]  inc;

    // choose note by counter appropriately
    always_comb
    case(key)
        4'b0111: inc = 8'd88; // C
        4'b1011: inc = 8'd111; // E
        4'b1101: inc = 8'd132; // G
        4'b1110: inc = 8'd148; // A
        default: inc = 0; // no note
    endcase

    // counter for digitally controlled oscillator
    always_ff @(posedge clk, posedge reset)
    if (reset) count <= 0;
    else      count <= count + inc;

    assign speaker = count[23];
endmodule

```

4. [2 for agreement within 1%, 1 for agreement within 10%] Table of actual output frequencies

Key	Note	Desired Frequency (Hz)	Actual Frequency (Hz)
KEY3	C	261.6	262.3
KEY2	E	329.6	330.8
KEY1	G	392	393.4
KEY0	A	440	441.1

5. [2] Does your system play music? **YES. Ring around the rosie.**

6. [1XC] Extra credit, if applicable

If you have suggestions for further improvements of this lab, you're welcome to include them at the end of your lab.