**FPGA Project Report**

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**1. Experiment Task**

Program your own BASYS2 board and implement an specific function. You can choose either the request on the instruction book or any other functions you like. The program language is Verilog.

**2. Program Description**

This program is for a little game called bulls and cows. Players can play this game on this board and get all the necessary information such as life number, illegal input, etc.

**3. Design Process**

In this experiment, I mainly designed five parts.

1. **The 7-segment display module.** In this part, I implement the basic display module of 7-sgment display: input a number and display it.

module ex4\_s( //7 segment display

input [3:0] NUM,

output reg[6:0] a\_to\_g

);

always @(\*)

case(NUM)

0:a\_to\_g=7'b0000001;

1:a\_to\_g=7'b1001111;

2:a\_to\_g=7'b0010010;

3:a\_to\_g=7'b0000110;

4:a\_to\_g=7'b1001100;

5:a\_to\_g=7'b0100100;

6:a\_to\_g=7'b0100000;

7:a\_to\_g=7'b0001111;

8:a\_to\_g=7'b0000000;

9:a\_to\_g=7'b0000100;

'hA: a\_to\_g=7'b0001000;

'hB: a\_to\_g=7'b1100000;

'hC: a\_to\_g=7'b0110001;

'hD: a\_to\_g=7'b1000010;

'hE: a\_to\_g=7'b0110000;

'hF: a\_to\_g=7'b0111000;

default: a\_to\_g=7'b0000001;

endcase

endmodule

1. **The input part.** In this part, I use four button to control the number that player wants to input. Use the clock to control the number changing speed.

always @( posedge clk\_cnt[23]) //Input part

begin

if((switch1)&(~switch2))

begin

if(temp\_a)

begin

temp\_1 = temp\_1+1;

if(temp\_1 == 10) temp\_1 = 0;

end

end

if(~switch1)temp\_1=0;

end

1. **The number generator (pseudo random).** In this part, I use clock to generate a number as the answer of this game. The number depends on the time from pushing on the total switch to pushing on the first switch.

always @( posedge clk\_cnt[23]) //Generate an answer with four different digital number

begin

if((switch1)&(life>0))

begin

if(r[3:0]>9)t[3:0]=r[3:0]-8;

if(r[7:4]>9)t[7:4]=r[7:4]-9;

if(r[11:8]>9)t[11:8]=r[11:8]-6;

if(r[15:12]>9)t[15:12]=r[15:12]-7;

if(r[3:0]<9)t[3:0]=r[3:0];

if(r[7:4]<9)t[7:4]=r[7:4];

if(r[11:8]<9)t[11:8]=r[11:8];

if(r[15:12]<9)t[15:12]=r[15:12];

if(t[15:12]==t[11:8])begin if(t[11:8]==9)t[11:8]=0;t[11:8]=t[11:8]+1;end

if(t[15:12]==t[11:8])begin if(t[11:8]==9)t[11:8]=0;t[11:8]=t[11:8]+1;end

if(t[15:12]==t[11:8])begin if(t[11:8]==9)t[11:8]=0;t[11:8]=t[11:8]+1;end

if(t[15:12]==t[11:8])begin if(t[11:8]==9)t[11:8]=0;t[11:8]=t[11:8]+1;end

if(t[15:12]==t[11:8])begin if(t[11:8]==9)t[11:8]=0;t[11:8]=t[11:8]+1;end

if(t[15:12]==t[11:8])begin if(t[11:8]==9)t[11:8]=0;t[11:8]=t[11:8]+1;end

if(t[15:12]==t[11:8])begin if(t[11:8]==9)t[11:8]=0;t[11:8]=t[11:8]+1;end

if(t[15:12]==t[11:8])begin if(t[11:8]==9)t[11:8]=0;t[11:8]=t[11:8]+1;end

if(t[15:12]==t[11:8])begin if(t[11:8]==9)t[11:8]=0;t[11:8]=t[11:8]+1;end

if((t[7:4]==t[15:12])|(t[7:4]==t[11:8]))begin if(t[7:4]==9)t[7:4]=0;t[7:4]=t[7:4]+1; end

if((t[7:4]==t[15:12])|(t[7:4]==t[11:8]))begin if(t[7:4]==9)t[7:4]=0;t[7:4]=t[7:4]+1; end

if((t[7:4]==t[15:12])|(t[7:4]==t[11:8]))begin if(t[7:4]==9)t[7:4]=0;t[7:4]=t[7:4]+1; end

if((t[7:4]==t[15:12])|(t[7:4]==t[11:8]))begin if(t[7:4]==9)t[7:4]=0;t[7:4]=t[7:4]+1; end

if((t[7:4]==t[15:12])|(t[7:4]==t[11:8]))begin if(t[7:4]==9)t[7:4]=0;t[7:4]=t[7:4]+1; end

if((t[7:4]==t[15:12])|(t[7:4]==t[11:8]))begin if(t[7:4]==9)t[7:4]=0;t[7:4]=t[7:4]+1; end

if((t[7:4]==t[15:12])|(t[7:4]==t[11:8]))begin if(t[7:4]==9)t[7:4]=0;t[7:4]=t[7:4]+1; end

if((t[7:4]==t[15:12])|(t[7:4]==t[11:8]))begin if(t[7:4]==9)t[7:4]=0;t[7:4]=t[7:4]+1; end

if((t[7:4]==t[15:12])|(t[7:4]==t[11:8]))begin if(t[7:4]==9)t[7:4]=0;t[7:4]=t[7:4]+1; end

if((t[3:0]==t[15:12])|(t[3:0]==t[11:8])|(t[3:0]==t[7:4]))begin if(t[3:0]==9)t[3:0]=0;t[3:0]=t[3:0]+1; end

if((t[3:0]==t[15:12])|(t[3:0]==t[11:8])|(t[3:0]==t[7:4]))begin if(t[3:0]==9)t[3:0]=0;t[3:0]=t[3:0]+1; end

if((t[3:0]==t[15:12])|(t[3:0]==t[11:8])|(t[3:0]==t[7:4]))begin if(t[3:0]==9)t[3:0]=0;t[3:0]=t[3:0]+1; end

if((t[3:0]==t[15:12])|(t[3:0]==t[11:8])|(t[3:0]==t[7:4]))begin if(t[3:0]==9)t[3:0]=0;t[3:0]=t[3:0]+1; end

if((t[3:0]==t[15:12])|(t[3:0]==t[11:8])|(t[3:0]==t[7:4]))begin if(t[3:0]==9)t[3:0]=0;t[3:0]=t[3:0]+1; end

if((t[3:0]==t[15:12])|(t[3:0]==t[11:8])|(t[3:0]==t[7:4]))begin if(t[3:0]==9)t[3:0]=0;t[3:0]=t[3:0]+1; end

if((t[3:0]==t[15:12])|(t[3:0]==t[11:8])|(t[3:0]==t[7:4]))begin if(t[3:0]==9)t[3:0]=0;t[3:0]=t[3:0]+1; end

if((t[3:0]==t[15:12])|(t[3:0]==t[11:8])|(t[3:0]==t[7:4]))begin if(t[3:0]==9)t[3:0]=0;t[3:0]=t[3:0]+1; end

if((t[3:0]==t[15:12])|(t[3:0]==t[11:8])|(t[3:0]==t[7:4]))begin if(t[3:0]==9)t[3:0]=0;t[3:0]=t[3:0]+1; end

answer1=t[3:0];

answer2=t[7:4];

answer3=t[11:8];

answer4=t[15:12];

end

end

1. **The comparison part.** In this part, I finish the comparison between the players number and the right answer. And display the result (mAnb).

else if((switch1)&(switch2))//judge

begin//if there are same numbers, blink

if(temp\_1==temp\_2)begin equal[0]=1;equal[1]=1;end

if(temp\_1==temp\_3)begin equal[0]=1;equal[2]=1;end

if(temp\_1==temp\_4)begin equal[0]=1;equal[3]=1;end

if(temp\_2==temp\_3)begin equal[1]=1;equal[2]=1;end

if(temp\_2==temp\_4)begin equal[1]=1;equal[3]=1;end

if(temp\_3==temp\_4)begin equal[2]=1;equal[3]=1;end

if(equal[3:0]==0)//if not, judging begins

begin

if(flag==0)

begin

flag=1;//--life

if(life>0)life=life-1;

if(life==8)light=8'b11111111;

else if(life==7)light=8'b11111110;

else if(life==6)light=8'b11111100;

else if(life==5)light=8'b11111000;

else if(life==4)light=8'b11110000;

else if(life==3)light=8'b11100000;

else if(life==2)light=8'b11000000;

else if(life==1)light=8'b10000000;

else if(life==0)light=8'b00000000;

end

rightpos=(temp\_1==answer1)+(temp\_4==answer4)+(temp\_2==answer2)+(temp\_3==answer3);

rightnum=(temp\_1==answer2)+(temp\_1==answer3)+(temp\_1==answer4)+(temp\_2==answer1)+(temp\_2==answer3)+(temp\_2==answer4)+(temp\_3==answer1)+(temp\_3==answer2)+(temp\_3==answer4)+(temp\_4==answer1)+(temp\_4==answer2)+(temp\_4==answer3);

//caculate m,n (mAnb)

1. **The extra part. (Include judging win and lose, LED that representing life, finding illegal input, etc. )**

**4. Deficiency and improvement:**

The component of show information of this board(such as LED, Display) is insufficient, so I can’t find a good way to indicate win or lose or some illegal input. Just use blink. I think it will be better to use buzzer.

**5. Matters need attention:**

When you push the second switch, you should do it swiftly to ensure it has been change from low to high only one time, or maybe it will trigger multiple event which leads to some bugs(Life will be reduced more than one during one judgment, for example.)