

2017 Digital IC Design

Homework 5: Color Transform Engine

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Simulation Result						
Testfixture 1 (YUV -> RGB)						
Functional simulation	Pass		Gate-level simulation		Pass	
Testfixture 2 (RGB -> YUV)						
Pattern 1	Functional simulation	Grade A	Gate-level simulation	Grade A	Gate-level simulation time	37726.3ns
Pattern 2	Functional simulation	Grade A	Gate-level simulation	Grade A	Gate-level simulation time	37726.3ns
Pattern 3	Functional simulation	Grade A	Gate-level simulation	Grade A	Gate-level simulation time	37726.3ns
Minimum CYCLE in Gate-level simulation				37726.3ns		
your pre-sim result of Testfixture 1				your post-sim result of Testfixture 1		
<pre>Transcript # # Congratulations! All data have been generated successfully! # # -----Function 1 (YUV->RGB) PASS----- # # ** Note: \$finish : C:/Users/eric/Desktop/HWS/testfixture1.v(126) # Time: 150301 ns Iteration: 0 Instance: /test # 1 # Break in Module test at C:/Users/eric/Desktop/HWS/testfixture1.v line 126 VSIM 5></pre>				<pre> # ----- # # Congratulations! All data have been generated successfully! # # -----Function 1 (YUV->RGB) PASS----- # # ** Note: \$finish : C:/Users/eric/Desktop/HWS/testfixture1.v(126) # Time: 37726300 ps Iteration: 0 Instance: /test # 1 # Break in Module test at C:/Users/eric/Desktop/HWS/testfixture1.v line 126</pre>		
your pre-sim result of Testfixture 2, pattern 1				your post-sim result of Testfixture 2, pattern 1		
<pre> # ----- # # Square Distance of All YUV = 46.000000 # # Square of All YUV Signal = 23195754.000000 # # ----- # # So Your Error Ratio: # # (Square Distance of YUV)/(Square of All YUV Signal) = 0.000002 # # ----- # # Your Score Level: A # # Congratulations! CTE's Function2 Successfully! # # -----PASS----- # # ** Note: \$finish : C:/Users/eric/Desktop/HWS/testfixture2.v(200) # Time: 150400 ns Iteration: 0 Instance: /test # 1 # Break in Module test at C:/Users/eric/Desktop/HWS/testfixture2.v line 200</pre>				<pre> # ----- # # Square Distance of All YUV = 46.000000 # # Square of All YUV Signal = 23195754.000000 # # ----- # # So Your Error Ratio: # # (Square Distance of YUV)/(Square of All YUV Signal) = 0.000002 # # ----- # # Your Score Level: A # # Congratulations! CTE's Function2 Successfully! # # -----PASS----- # # ** Note: \$finish : C:/Users/eric/Desktop/md_fn2_post/testfixture2.v(200) # Time: 37750400 ps Iteration: 0 Instance: /test # 1 # Break in Module test at C:/Users/eric/Desktop/md_fn2_post/testfixture2.v line 200</pre>		
your pre-sim result of Testfixture 2, pattern 2				your post-sim result of Testfixture 2, pattern 2		

<pre> # ----- # Square Distance of All YUV = 43.000000 # Square of All YUV Signal = 22233632.000000 # ----- # So Your Error Ratio: # (Square Distance of YUV)/(Square of All YUV Signal) = 0.000002 # ----- # Your Score Level: A # Congratulations! CTE's Function2 Successfully! # -----PASS----- # ** Note: \$finish : C:/Users/eric/Desktop/HWS/testfixture2.v(200) # Time: 150400 ns Iteration: 0 Instance: /test # 1 # Break in Module test at C:/Users/eric/Desktop/HWS/testfixture2.v line 200 </pre>	<pre> # ----- # Square Distance of All YUV = 43.000000 # Square of All YUV Signal = 22233632.000000 # ----- # So Your Error Ratio: # (Square Distance of YUV)/(Square of All YUV Signal) = 0.000002 # ----- # Your Score Level: A # Congratulations! CTE's Function2 Successfully! # -----PASS----- # ** Note: \$finish : C:/Users/eric/Desktop/md_fn2_post/testfixture2.v(200) # Time: 37750400 ps Iteration: 0 Instance: /test # 1 # Break in Module test at C:/Users/eric/Desktop/md_fn2_post/testfixture2.v line 200 </pre>
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<p>your pre-sim result of Testfixture 2, pattern 3</p> <pre> # ----- # Square Distance of All YUV = 38.000000 # Square of All YUV Signal = 21561234.000000 # ----- # So Your Error Ratio: # (Square Distance of YUV)/(Square of All YUV Signal) = 0.000002 # ----- # Your Score Level: A # Congratulations! CTE's Function2 Successfully! # -----PASS----- # ** Note: \$finish : C:/Users/eric/Desktop/HWS/testfixture2.v(200) # Time: 150400 ns Iteration: 0 Instance: /test # 1 # Break in Module test at C:/Users/eric/Desktop/HWS/testfixture2.v line 200 </pre>	<p>your post-sim result of Testfixture 2, pattern 3</p> <pre> # ----- # Square Distance of All YUV = 38.000000 # Square of All YUV Signal = 21561234.000000 # ----- # So Your Error Ratio: # (Square Distance of YUV)/(Square of All YUV Signal) = 0.000002 # ----- # Your Score Level: A # Congratulations! CTE's Function2 Successfully! # -----PASS----- # ** Note: \$finish : C:/Users/eric/Desktop/md_fn2_post/testfixture2.v(200) # Time: 37750400 ps Iteration: 0 Instance: /test # 1 # Break in Module test at C:/Users/eric/Desktop/md_fn2_post/testfixture2.v line 200 </pre>
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Synthesis Result	
Total logic elements	495
Total memory bit	0
Embedded multiplier 9-bit element	0

(your flow summary)

Flow Summary	
Flow Status	Successful - Tue Dec 26 14:42:43 2017
Quartus II Version	10.0 Build 262 08/18/2010 SP 1 SJ Full Version
Revision Name	CTE
Top-level Entity Name	CTE
Family	Cyclone II
Device	EP2C70F896C8
Timing Models	Final
Met timing requirements	No
<div> <div></div> <div>Total logic elements</div> </div>	495 / 68,416 (< 1 %)
<div> <div></div> <div>Total combinational functions</div> </div>	495 / 68,416 (< 1 %)
<div> <div></div> <div>Dedicated logic registers</div> </div>	77 / 68,416 (< 1 %)
Total registers	77
Total pins	70 / 622 (11 %)
Total virtual pins	0
Total memory bits	0 / 1,152,000 (0 %)
Embedded Multiplier 9-bit elements	0 / 300 (0 %)
Total PLLs	0 / 4 (0 %)

Description of your design

根據 HW5 的作業說明，依照 op_mode 訊號來分辨是做 function1 還是 function2，並控制 counter、busy、out_vaild 做不同的行為來符合需求，function1 的部分寫一個循序電路吃 clock 用來將 yuv_in 循序吃進大小為 3 的 array，並依序放成 Y、U、V，並餵給一個循序電路做矩陣運算，用位移的方式達到小數乘法的概念，再做四捨五入後將 output 結果丟出來檢查。function2 的部分用同樣用循序電路來將 24bit 的 rgb_in 依照位置切出各 8bit 的 R、G、B，吃進大小為 3 的 array，再將 array 的資料給組合電路做矩陣運算，循環小數的部分先將該小數乘 1024 來達到位移 10bit 的效果並擷取整數部分的 10bit 精度，用該數對 RGB 做相應矩陣乘法後再做正數四捨五入、負數五捨六入，並將結果再右移 10bit 恢復成正確所需數字，最後把結果丟給 yuv_out。

*Scoring = (Total logic elements + total memory bit + 9*embedded multiplier 9-bit element) × (longest gate-level simulation time in ns)*