Points	Grade

Team: XX

MatNr. First SECOND #1
MatNr. First SECOND #2
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Digital Integrated Circuits Lab (LDIS)

384.088, Summer Term 2019

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Task 2:

Design Characterization, Bus Communication

1 Characterize your design from Task 1

In order to make your design implementation comparable to other implementations, simulate your design using Vivado and perform the following measurements:

1. Timing analysis
2. Power analysis
3. Resource consumption

Create a design space vector for your design.The design space vector holds the following parameters, where t_{max} is the maximum delay for the critical path, P_{avg} is the average power consumption for your design (vector-less post-place-and-route power estimation), and r is the percentage of resources used in your implementation for the Nexys 4 DDR board (for sake of simplicity, use the percentage of slices):

$$\vec{v} = \begin{bmatrix} t_{max} \\ P_{avg} \\ r \end{bmatrix} \tag{1}$$

You will find information on power estimation[1] and timing analysis[2] on the web.

Get the design space vectors of your colleagues, and visualize the three-dimensional design space. Use black crosses for the vectors of your colleagues, and a filled circle for your own vector.

2 Create an AMBA APB interface

The goal of this subtask is to make your design accessible from other intellectual property (IP) cores via the advanced microcontroller bus architecture (AMBA) advanced peripheral bus (APB). Consult the APB specification,[3] and:

1. Implement a bus controller that implements the use case for your task
2. Implement a bus interface for any sub-component of your design from Task 1 (sampling, data processing, output).
3. Implement a module that takes the user input for runtime parameters and connect it to the bus

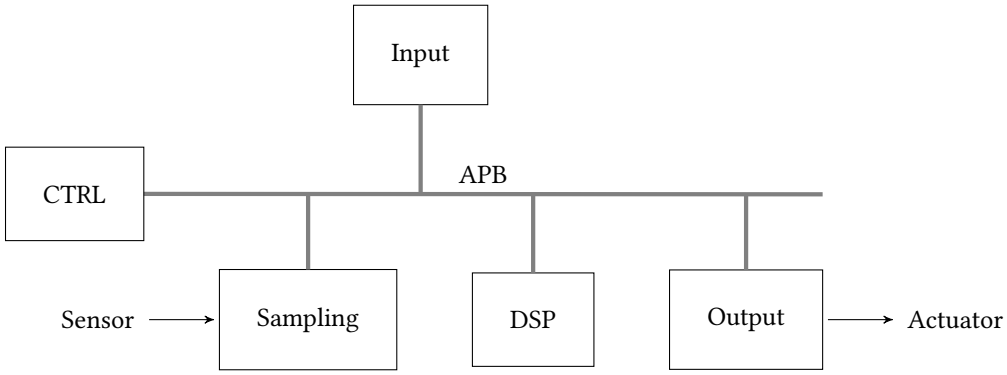

Figure 1: System of Task 1 equipped with an APB

Your system should be able to take the user input, parametrize the system according to the user input, and perform the actual task. Instead of directly connecting each of the sub-components directly, the modules should communicate over the APB. The audio system can be treated as one module; as it is kind of a real-time system, it wouldn't make a lot of sense to let it communicate over the APB. The user-input (e.g., cut-off freuqency) should be set over the APB.

[1] *Vivado Design Hub - Power Estimation & Optimization.* URL: https://www.xilinx.com/support/documentation-navigation/design-hubs/dh0008-vivado-power-estimation-and-optimization-hub.html.

[2] *Vivado Design Hub - Timing Closure & Design Analysis.* URL: https://www.xilinx.com/support/documentation-navigation/design-hubs/dh0006-vivado-design-analysis-and-timing-closure-hub.html.

[3] *AMBA 3 APB Protocol Specification.* Tech. rep. ARM Ltd., Aug. 17, 2004. URL: http://web.eecs.umich.edu/~prabal/teaching/eecs373-f12/readings/ARM_AMBA3_APB.pdf.