Custom Peripheral Datasheet

Custom Peripheral: Image Filter and Convolution operator
Version: 1.0
Tagline: An Image blurring Gaussian filter.

Exam number: Y3941772

Key Features:

1. Contains a 3x3 image filter that performs convolution operation on images, and outputs a blurred version of the original image.
2. AXI4 Peripheral, for seamless integration with microprocessors.
3. Simple and efficient integration with the ARM processor on the ZYNQ SoC.
4. This Custom IP supports configuration and data transfer between the processor and the peripheral
5. Image tiling is performed for efficient memory usage and processing.
6. The ARM processor divides the image into tiles of 9x9, sends them to the peripheral, and reassembles the filtered image.
7. Utilizes block RAM (BRAM) to store image tiles during processing and reduces external memory access.
8. Compatible with standard grayscale images such as pgm/pcm formats for easy integration with software.
9. The communication with the FPGA peripheral is performed using Embedded C.
10. Designed for minimal processing delay, suitable for real-time applications.

Overview

This 3x3 Image Filter Peripheral is a custom hardware accelerator that has been created to relieve the ARM processor in the XILINX ZYNQ SoC of Cortex field from the image-processing tasks that involve convolution. Use from high-speed processing of 3x3 convolutions for grayscale images allowing the concept of blurring, edge detection, and sharpening. With real-time performance as the main consideration, the peripheral blends easily with the ZYNQ SoC.

The custom peripheral is integrated with the AXI4 interface,through which it receives image times from the ARM processor. It performs the convolution operation of the Gussian blur using the configured 3x3 kernel, and then sends the filtered image data back. These filtered image pixels are collected and rearranged to form a new image. On

chip, block RAM is utilised for buffering that minimizes external memory access. This system handles large grayscale images in pgm/pcm format.
The final output can be sent to the PC for visualisation, and enables side by side comparison of the original and filtered Image. This is an ideal peripheral for vision applications that require real-time image processing, such as medical imaging, robotics and industrial automation.

Parameters

Parameters	**Value**
Clock Frequency	Up to 100MHz
Data Width	16-bit, 32-bit
Interface	AXI4

Register Map

Register name	**Address**	**Bit field**	**Description**
slv_reg0	0x00	[15 : 0]	Input data for IP
slv_reg2	0x08	[15 : 0]	Input data for IP
slv_reg3	0x0C	[15 : 0]	Input data for IP
slv_reg4	0x10	[15 : 0]	Input data for IP
slv_reg5	0x14	[15 : 0]	Input data for IP
slv_reg6	0x18	[15 : 0]	Input data for IP
slv_reg7	0x1C	[15 : 0]	Input data for IP
slv_reg8	0x20	[15 : 0]	Input data for IP
slv_reg9	0x24	[15 : 0]	Input data for IP
slv_reg1	0x04	[31 : 0]	Output data for IP

Conclusion

The 3x3 Image filtering Custom peripheral is a high performance, hardware accelerator tha tperforms image processing on the Xilinx ZYNQ SoC. With programmable filter coefficients, and an AXI4 Interface. It performs the operation fo blurring the image using the Gaussian Blurr filter.It intakes a ogm/pcm greyscale image and returns the blurred image as its output. This is a suitable for embedded vision applications such as noise reduction, preprocessing of images, or background blurring for medical imaging, etc.
Its integration with PC visualisation capabilities make it a decent tool for real time image filtering.