

INFIERI 2014 Lab 6/7

Field Programmable Gate Arrays – Detecting Cosmic Rays



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Field Programmable Gate Array

2

- User programmable integrated circuit
 - 2-D array of configurable logic blocks interconnected by a programmable matrix.
 - Used to design digital electronics.
- Circuit design decided by end-user, not the chip designer.
- Development cycle fast and economical.
- Digital signal processing, aerospace, medical imaging ...
- Massive application in particle physics instrumentation
 - Trigger algorithms
 - Data acquisition
 - System controller

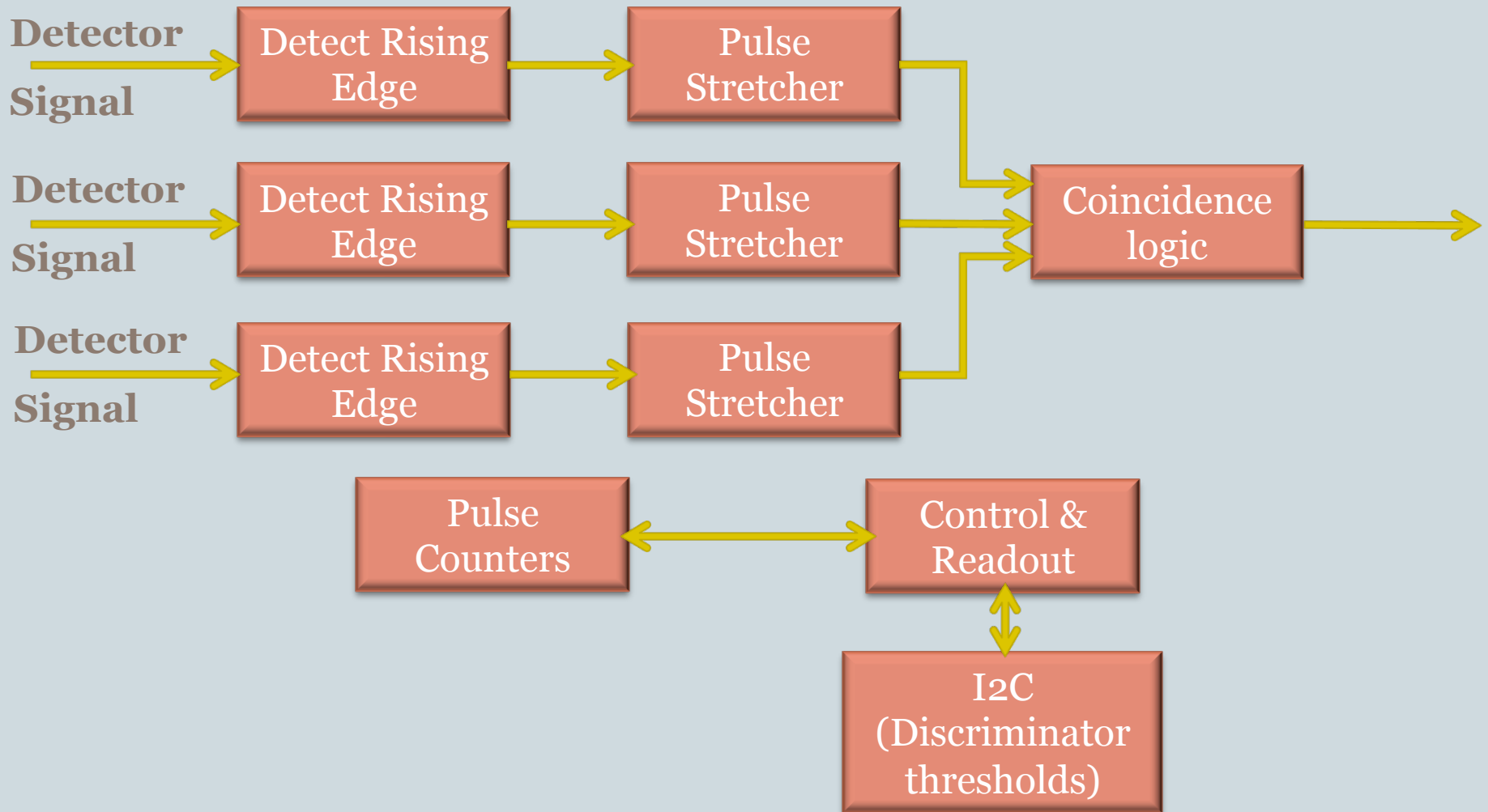
Overview

3

- Detect coincidence of signals produced by cosmic rays in multiple detectors (scintillators coupled to photomultipliers).
- Count rates of input signals and coincidence output.
- Logic implementation
 - Written in VHDL.
 - Programmed onto an FPGA on a Xilinx evaluation board.
- Control and readout using IPbus
 - A protocol based on gigabit Ethernet.
 - Developed as part of CMS upgrade at LHC.

Experimental Set-up

4



The Exercise

5

- Write few HDL blocks to complete the circuit.
- Generate a configuration file for the FPGA using the ISE toolkit.
- Load configuration into the FPGA.
- Test functionality of the circuit by probing signals on an oscilloscope.
- Write a Python script to read out the rates of the input signals and the coincidence output.