

基于 FPGA 的 Separable Gabor 滤波器设计

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摘要: 指纹图像滤波是指纹图像增强耗时最大的过程, 为提高指纹滤波的实时性, 提出了一种 Separable Gabor 滤波器, 将二维的 Gabor 滤波器分别拆分为一维带通滤波器和一维低通滤波器. 两种滤波器在互相垂直的方向上分别对指纹图像进行卷积. 该算法用硬件描述语言在可编程逻辑门阵列 (FPGA) 上实现. 为了节省存储空间, 引入了坐标变换和方向变换. 实验结果表明, 对于同一幅指纹图像, Separable Gabor 滤波器和 Gabor 滤波器的处理结果相似, 且前者的处理速度是后者的 1.9 到 4 倍, 存储空间的消耗仅为 Gabor 滤波器的 16.4%, 提高了滤波速度的同时极大的降低了硬件成本.

关键词: 指纹; 图像增强; Separable Gabor 滤波器; FPGA

Design of Separable Gabor Filter Based on FPGAs

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Abstract: Fingerprint image filtering is the most time-consuming process of fingerprint image enhancement. In order to improve the real-time performance of fingerprint filtering, a Separable Gabor filter is proposed. The two-dimensional Gabor filter is split into a one-dimensional band-pass filter and a one-dimensional low-pass filter. Two filters respectively convolute the fingerprint image in mutually perpendicular directions. The algorithm is realized on FPGA using hardware description language. In order to save memory space in the implementation process, coordinate transformation and direction transformation were introduced. Experimental results show that for the same fingerprint image, the processing results of the Separable Gabor filter and the Gabor filter are similar, and the former is 1.9 to 4 times faster than the latter, the consumption of memory space of the Separable Gabor filter is only 16.4% of the Gabor filter. Increases the filtering speed while greatly reducing hardware costs.

Key words: image enhancement; separable gabor filter; FPGA

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