Implementation of Multilevel Thresholding Process Using Histogram Valley Estimation Method Based on FPGA

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Abstract. An automatic multilevel thresholding algorithm called histogram-based valley estimation method (HVEM) based on a field programmable gate array (FPGA) is presented for segmenting an image into multiple homogeneous regions. The major contributions and benefits of this paper are as follows: (1) the proposed method is computationally efficient because it eliminates the expensive computations due to repeated arithmetic operations such as multiplications and divisions in Otsu's method, making it much easier to implement on an FPGA device; (2) the method is capable of automatically determining the number of clusters by estimating possible valleys in the histogram of real world images; and (3) the accuracy of the method is comparable to that of Otsu's method in threshold determination, which is achieved by evaluating the mean structural similarity (MSSIM) and uniformity. The synthesis results of the FPGA chip system indicate that the operation speed can reach up to 191.0 MHz, which is equivalent to the processing rate of 969 frame/s for gray level images of size 256 × 256. The performance meets the requirements for a real-time image processing system..

Keywords: Otsu's method, multilevel thresholding, image segmentation, filed programmable gate array (FPGA)

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