SPECIAL ISSUE

FPGA-based IP cores implementation for face recognition using dynamic partial reconfiguration

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Abstract This paper presents a combination of novel feature vectors construction approach for face recognition using discrete wavelet transform (DWT) and field programmable gate array (FPGA)-based intellectual property (IP) core implementation of transform block in face recognition systems. Initially, four experiments have been conducted including the DWT feature selection and filter choice, features optimisation by coefficient selections and feature threshold. To examine the most suitable method of feature extraction, different wavelet quadrant and scales have been evaluated, and it is followed with an evaluation of different wavelet filter choices and their impact on recognition accuracy. In this study, an approach for face recognition based on coefficient selection for DWT is presented, and the significant of DWT coefficient threshold selection is also analysed. For the hardware implementation, two architectures for two-dimensional (2-D) Haar wavelet transform (HWT) IP core with transpose-based computation and dynamic partial reconfiguration (DPR) have been synthesised using VHDL and implemented on Xilinx Virtex-5 FPGAs. Experimental results and comparisons between different configurations using partial and non-partial reconfiguration processes and a detailed performance analysis of the area, power consumption and maximum frequency are also discussed in this paper.

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1 Introduction

The use of biometric systems is growing rapidly. Face recognition technology has the potential to be a convenient, robust biometric, used for many applications [1]. Currently, recognition rates are adversely affected by variation in illumination, pose, gesture and other factors [2]. Much research is currently being undertaken in face recognition and has a large number of potential applications, such as port of entry logging, building access control, criminal identification and attendance logging [3]. On top of that, a number of commercial face recognition systems have been developed, including products from Cognitec [4], L-1 Identity Solutions [5], Geometrix [6], Technest [7] and Animetrics [8].

In this study, both software simulations and an implementation of intellectual property (IP) core for transform block in the face recognition systems are discussed. Initially, four experiments have been conducted including the discrete wavelet transform (DWT) feature selection and filter choice, features optimisation by coefficient selections and feature threshold. To examine the most suitable method of feature extraction, different wavelet quadrant and scales have been evaluated, and it is followed with an