Special issue on real time biometrics and secure media

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This Special Issue of the Springer Journal of Real Time Image Processing entitled “Real Time Biometrics and Secure Media” is dedicated to the areas of biometrics, surveillance, authentication and secure communications. The issue is oriented toward both theoretical and practical aspects and in the spirit of the journal, the emphasis is on the trade-offs necessary for achieving Real Time performance. This special issue contains eight contributions.

Fons et al. propose an FPGA architecture for an automatic fingerprint authentication system (AFAS). Automatic fingerprint authentication is a good example of a research area covering computational-intensive algorithms composed of a series of image processing tasks executed in a sequential order. The proposed architecture is based on concepts from hardware/software (HW/SW) co-design and run-time reconfigurable computing. Tasks are partitioned and synthesised first in a series of allocated coprocessors and subsequently the multiplexed tasks are executed in real time on a partially reconfigurable region (PRR) of the FPGA. The implementation benchmark of the AFAS either as a pure software approach on a PC platform under a dual-core processor (Intel Core 2 Duo T5600 at 1.83 GHz) or as a reconfigurable FPGA co-design (identical algorithm partitioned in HW/SW tasks operating at 50 or 100 MHz on the second smallest device of the Xilinx Virtex-4 LX family) highlights a speed-up of one order of magnitude in favor of the FPGA alternative over general purpose

processors. The authors claim that the proposed approach is easily generalisable in other biometric applications.

Laadjel et al. present a bimodal biometric recognition system based on the extracted features of the human palmprint and iris. The system uses a new graph based approach termed Fisher Locality Preserving Projections (FLPP). This new technique employs two graphs with the first being used to characterize the within-class compactness while the second being dedicated to the augmentation of the between-class separability. By applying the FLPP, only the most discriminant and stable palmprint and iris features are retained. FLPP was implemented on the frequency domain by transforming the extracted region of interest (ROI) of both biometric traits using Fourier transform. Subsequently, the obtained palmprint and iris feature vectors are matched with their counterpart in the templates databases and the obtained scores are fused to produce the final decision. The proposed combination of palmprint and iris patterns has shown an excellent performance compared to unimodal palmprint biometric. The system was tested on a database of 108 subjects and the experimental results show that it achieves a high accuracy expressed by an Equal Error Rate (EER) of 0.00 %.

Badrinath et al. present an efficient indexing scheme for palmprint based identification. The approach uses geometric hashing of SURF key-points to index the palmprint into a hash table and uses a fusion based voting strategy on the hashes to identify the live palmprint. The system has been tested on the IITK, CASIA and PolyU datasets. It was observed that the penetration rate was <30 % for 0 % bin miss rate and the system had identification accuracy >97 % for all three datasets. Furthermore, the identification accuracy of the system for the top best match was more than 90 % for images, downscaled up to 49 % and more than 85 % for images rotated at any angle.

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Sarfaz et al. propose an efficient real time Automatic License Plate Recognition (ALPR) framework designed to operate on CCTV video footage obtained from general purpose cameras. The framework consists of a novel approach for efficient localization of license plates in video sequences and subsequently uses a revised version of an existing technique for tracking and recognition. Special features of the proposed approach are the intelligent automatic adjustments for varying camera distances and diverse lighting conditions, a requirement for a forensic video tool that may operate on videos obtained by a diverse set of unspecified, distributed CCTV cameras.

Tanugast et al. introduce a robust and compact architecture of a hardware chaotic key generator for real time image encryption. The scheme combines perturbation with non-linear switching between multiple three-dimensional continuous chaotic systems. The originality of the scheme is that it allows a low cost image encryption for embedded systems while still providing a good trade-off between performance and hardware resources. Numerical simulations and realtime experimental results using Xilinx FPGA Virtex technology have demonstrated the feasibility and the efficiency of the scheme, which can be used to secure real-time embedded applications on System on Chip (SoC) platforms. The proposed fast encryption scheme is also shown to be robust against statistical and key analysis attacks.

Abhayaratne proposes a scalable authentication scheme based on the progressive enhancement functionality of JPEG 2000 scalable image coding. The technique uses the wavelet-based quality scalable coding to model and identify the effect of the quantization and de-quantization on wavelet coefficient magnitudes and the data embedded within these coefficients. Then a relationship between the watermark extraction rule and the embedding rule is established using the magnitudes of the reconstructed and original coefficients by ranking the wavelet coefficients according to their ability to retain the embedded watermark data intact under various quantization levels corresponding to quality enhancements. At the decoder side, quality and resolution layers are decoded, thereby improving the authentication metric. Such decoding results in a gradually increasing complexity of the authentication process, depending on the quality and the number of resolution enhancement layers. The low complexity authentication is available at low quality resolution decoding, thus enabling real-time authentication for resource constrained applications without affecting the authentication metric.

Afandi et al. present a paper combining a novel feature vectors construction approach using discrete wavelet transform (DWT) and field programmable gate array (FPGA) technology for rapid face recognition. Different wavelet quadrant and scales have been evaluated including the effect of different wavelet filter choices and their impact on recognition accuracy. An approach based on coefficient selection for DWT is then proposed using a suitable DWT coefficient threshold selection. 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.

Panda et al. propose a technique to improve the time complexity of an existing geometric hashing based indexing approach for iris biometric recognition. In the conventional approach, the annular iris image is used for extraction of key points using Scale Invariant Feature Transform and achieving an accuracy of 98.5 % though computationally intensive processes. In order to improve time complexity, an existing geometric hashing approach is carried out in parallel during indexing as well as during the retrieval phase. In the proposed approach, the extracted key points are mapped to processors on a hypercube architecture with a shared global memory structure. The geometric invariants are obtained for each basis pair and allotted to individual processors in parallel. During the indexing phase, the invariants are stored in the hash table for later use at the retrieval phase, where the corresponding invariants are compared in the hash table using a voting method. The architecture has resulted in a time complexity of the order of $O(Mn^2)$ for M iris images each having n key points. This compares favorably against the conventional approach having a time complexity of $O(Mn^3)$ thus making the approach suitable for real time implementations.

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Sincerely

Christos Grecos and Ahmed Bouridane (Guest editors)