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EDITORIAL

IEEE ACCESS SPECIAL SECTION EDITORIAL: VISUAL SURVEILLANCE AND BIOMETRICS: PRACTICES, CHALLENGES, AND POSSIBILITIES

Visual surveillance is the latest paradigm for social security through machine intelligence. It includes the use of visual data captured by infrared sensors or visible-light cameras mounted in cars, corridors, traffic signals etc. Visual surveillance facilitates the classification of human behavior, crowd activity, and gesture analysis to achieve application-specific objectives.

Biometrics is the science of uniquely identifying or verifying an individual among a set of people by exploring the user's physiological or behavioral characteristics. Due to their ease of use in many application scenarios (including time attendance systems, border control, access control for high security, etc.), biometric systems are currently being introduced in many everyday activities.

In the past, some solutions developed for visual surveillance systems have also been applied for biometric identification. Recently, various research efforts have been devoted to merge these two technologies, especially for adverse and covert scenarios. This Special Section, ''Visual Surveillance and Biometrics: Practices, Challenges, and Possibilities,'' serves as a cross-platform to cover the recent advances at the intersection of 'visual surveillance' and 'biometrics.' It contains 20 cutting-edge research articles by leading researchers from more than fifteen countries, discussing the current challenges and possible solutions in both fields.

The selected articles can be clustered into three main categories: 1) Surveillance-oriented biometric technologies; 2) Emotion and expression recognition in visual surveillance; and 3) Object detection and tracking in visual surveillance. The remainder of this section overviews the articles published under these categories, and highlights their significance and features.

The novel works that focus on surveillance-oriented biometric technologies mostly deal with approaches based on the analysis of different biometric traits like the iris, the periocular area of the face, and the whole face. Algashaam *et al.*, in ''Multispectral periocular classification with multimodal compact multi-linear pooling,'' discuss a multispectral periocular classification based on a compact multi-linear pooling to accommodate multispectral inputs from multiple sources. The authors apply a higher order spectral analysis in their approach.

In a similar research direction, Mahmood *et al.*, in ''Multi-order statistical descriptors for real-time face recognition and object classification,'' utilize multi-order statistical descriptors for real-time face recognition. Following the successful application of deep learning, in an invited article by Nguyen *et al.*, ''Iris recognition with off-the-shelf CNN features: A deep learning perspective,'' the authors propose an iris recognition approach exploiting off-the-shelf CNN features. Along with boosting the iris recognition rate, CNNs are shown to be critical in learning new iris encoding schemes, which is useful for large scale applications.

The remaining four articles included in this category notably improve the current state-of-the-art of biometric systems for robustness. In ''Webcam-based eye movement analysis using CNN,'' Meng and Zhao tackle the problem of single feature point (e.g. iris center) based eye tracking proposing a tracking algorithm which is based on five eye feature points. A CNN architecture is applied for identifying the eye feature points and the eye movement patterns. Sanchez-Reillo *et al.*, in ''Forensic validation of biometrics using dynamic handwritten signatures,'' propose a novel approach for forensic validation of online handwritten signatures by applying graphonomics to the graphometric features of the signature under evaluation.

Dilawari *et al.*, in ''Natural language description of video streams using task-specific feature encoding,'' present a novel approach to generate a natural language description of video streams through the extraction of visual features from video frames using a deep CNN. To generate the natural language description, the synthesized representation is finally processed by a LSTM-based language model.

In ''Continuous wavelet transform based no-reference image quality assessment for blur and noise distortions,'' Joshi and Prakash analyze the reason for performance degradation of a biometric or surveillance system due to the blurring and geometric distortion of the input data. The key feature of the proposed approach is a continuous wavelet-based no-reference image quality assessment module, which can be well integrated as a pre-processing step of any biometric or surveillance system. To summarize, these four research articles, addressing different challenges of biometric and

surveillance systems, can boost the overall performance of a recognition system.

The detection of the facial expression, the perceived emotional state, and the performed actions of human beings play a significant role in developing an intelligent and proactive surveillance system. Among the articles included in this Special Section, this category contains articles addressing these topics. Zia Uddin *et al.*, in ''Facial expression recognition using salient features and convolutional neural network,'' present a facial expression recognition system based on the extraction of salient facial features by applying LDRHP, LDSP, KPCA, and GDA, and combining these features by means of a deep CNN architecture.

Guo *et al.*, in ''Dominant and complementary emotion recognition from still images of faces," observed that compound emotion detection systems are generally evaluated on datasets including a limited number of classes and with an unbalanced data distribution. Therefore, they introduce and report the best performance obtained on a new dataset named iCV-MEFED.

Ullah *et al.*, in ''Action recognition in video sequences using deep bi-directional LSTM with CNN features,'' and Chou *et al.*, in ''Robust feature-based automated multi-view human action recognition system,'' present novel human action recognition systems based on a feature-based analysis of multi-view video sequences.

The articles focused on object detection and tracking in visual surveillance interestingly span from an attentional mechanism for head tracking based on simulated brain programming to object tracking in outdoor surveillance videos.

Wang *et al.*, in ''M^4CD: A robust change detection method for intelligent visual surveillance,'' propose a robust change detection method for intelligent visual surveillance where both the color and texture cues are integrated into a sample-based background model. Change detection is often the basis for higher-level tasks in visual surveillance. Changes in illumination, pose, scale and occlusions are often major challenges for robust object tracking. To address these issues, in ''Complex form of local orientation plane for visual object tracking,'' Cen and Jung propose a correlation filtering approach to extract a robust descriptor embedding the spatiotemporal relationship between the target and its surrounding region.

Olague *et al.*, in ''Evolving head tracking routines with brain programming,'' propose an artificial dorsal stream model to perform object detection for head tracking. A smooth pursuit motion model is also applied to dynamically update the estimated target position. Yang *et al.*, in ''long-distance object recognition with image super resolution: A comparative study,'' present a comparative study on six super-resolution methods applied to two baseline object recognition algorithms.

He *et al.*, in ''Fast Fourier transform networks for object tracking based on correlation filter,'' propose fast Fourier transform networks (FFTNet) for accurate and computationally efficient object tracking. FFTNet is implemented as a filter-based tracker combining the auto and cross-correlation among the features extracted from two video frames.

Chu *et al.*, in ''Object detection based on multi-layer convolution feature fusion and online hard example mining,'' propose a novel method to detect objects of different sizes in videos from traffic scenes. Variable-size object detection is performed by applying the Multi-Layer Convolution Feature Fusion (MCFF) and the Online Hard Example Mining (OHEM) algorithm. Along the same research direction, Li *et al.*, in ''Road traffic anomaly detection based on fuzzy theory,'' present a Fuzzy logic-based anomaly detection system applied to videos captured from road traffic scenes. Traffic anomalies are detected by performing a fuzzy fusion of multiple information extracted from the video stream.

Liu *et al.*, in ''An ensemble deep learning method for vehicle type classification on visual traffic surveillance sensors,'' propose an ensemble deep learning approach for vehicle classification in videos captured from traffic scenes. Finally, in ''Dataset optimization for real-time pedestrian detection,'' Trichet and Bremond highlight the impact of poorly chosen training data on the performance of pedestrian detectors. They propose a new data selection technique exploiting the expectation-maximization algorithm for data weighting.

The articles collected in this Special Section describe the current research trend in the emerging field that crosses the boundaries between biometric recognition and visual surveillance. It is expected and hoped that the articles in this Special Section will inspire other researchers working in both fields, while providing a foundation for further investigation. The editors would like to thank all contributing authors for submitting their works, the reviewers for their constructive criticisms and fine analysis on the submissions, and the editorial office of IEEE ACCESS for the endless support. We especially would like to thank Dr. Bora Onat, Managing Editor of IEEE ACCESS, for helping in the smooth production of this Special Section.

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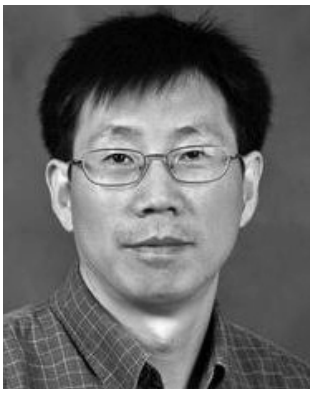

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