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EDITORIAL

Guest editorial: Recent trends in multimedia data-hiding: a reliable mean for secure communications

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1 Introduction

Recently, multimedia stands as one of the most demanding and exciting aspects of the information era and every moments several multimedia information are created and transmitted all around the world through different unsecured networks (Singh et al. 2017). Digital document distribution over open channel using information and communication technology (ICT) has proved an indispensible and cost effective technique for dissemination and distribution of digital media files (Singh et al. 2017; Agrawal et al. 2019; Podilchuk and Delp 2001). However, prevention of copyright violation, ownership identification, and identity theft have been challenging issues due to attempts of malicious attacks/hacking of open channel information (Singh et al. 2017). The prime motive behind attacks can be to alter, modify, or even delete the document watermark to illegally claim ownership or preventing the information transfer to intended recipients. Therefore, addressing these challenges has been an interesting problem for researchers in the field. One such effort that has been attracting interest is based on multimedia data hiding, which is a technique to hide multimedia data into a cover message without creating any perceptual distortion of the cover for identification, annotation and copyright (Singh et al. 2018; Mohanty et al. 2017). In recent years, multimedia data hiding techniques develops very fast and applies to many applications, such as E-health, military, communication, privacy protection, identification, media file archiving, broadcast monitoring, hardware and chip level security, remote education and insurance companies, secured E-voting systems, fingerprinting, real time audio/video, robotics, rightful ownership of identity card and digital cinema (Singh et al. 2017; Mohanty et al. 2017).

Our Call for Papers received an enthusiastic response with 31 high-quality submissions. Per the journal policy, it was ensured that handling editors did not have any potential conflict of interest with authors of submitted articles. All articles were reviewed by at least two independent potential referees. The articles were evaluated for their rigor and quality, and also for their relevance to the theme of our Special Issue. After a rigorous review process, we accepted 11 articles to form the Special Issue. The brief summary about each paper is presented as follows.

2 Summary of the accepted papers

The contribution by Parah et al. "*An efficient watermarking technique for tamper detection and localization of medical images*" proposes a computationally efficient fragile watermarking technique for tamper detection and localization of medical/general images. The experimental study on various images reveals that the technique is capable of detecting and localizing tamper caused to the watermarked images during its transit to receiver. The high image fidelity, lesser computational complexity and better payload make the proposed scheme a better candidate for authenticating the medical imagery for real time applications like e-healthcare.

In "*Video Transcoding Scheme of Multimedia data-hiding for Multiform Resources based on Intra-Cloud*", *Park* et al. *described a scheme for* multiform video resources that

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provide the framework for developing a video transcoding scheme of multimedia data-hiding. Based on the intra-cloud environment, the scheme uses the computing power of a small-scale server group of the internal network as a computing resource to jointly accomplish a large task. The proposed scheme of multimedia data-hiding platform can support videos of multiple formats by transcoding and generating multi-resolution resources from the received single video resource. In addition, these complex tasks are executed efficiently using an optimized task assignment algorithm.

In the contribution by Elhoseny et al. "*Secret Image Sharing Scheme with Encrypted Shadow Images using Optimal Homomorphic Encryption Technique*", a wavelet-based secret image sharing scheme using optimal Homomorphic Encryption is proposed. The results reveal that the proposed scheme ensures best reconstruction of images with desirable quality due to the tunable feature in the secret shadows. From the optimal public-key is increased security: the private keys do not ever need to be transmitted images. The secret key values may be different from one image to another which adds more ambiguity at the side of attackers about the key itself.

In "*Hybrid domain watermarking technique for copyright protection of images using speech watermarks*", Thanki and Kothari developed hybrid domain image watermarking technique using watermark speech signal. For non-blind extraction of the watermark speech signal, original hybrid coefficients of cover image and information of selected matrices of the watermark speech signal are required as secret keys. The comparative analysis shows that this technique performs better than existing techniques for all requirement of watermarking techniques. This proposed technique may be used for copyright protection of images as well as speech signal security at the storage of the biometric system. The performance of the proposed technique is tested for various types of multimedia data such as gray scale images, color images, TIMIT database speech signals.

The contribution by Pan et al. "*A study on user recognition using 2D ECG based on ensemble of deep convolutional neural networks*" presents a user recognition method based on ensemble networks using ECG signals. To apply 1D ECG signals to the CNN to exhibit excellent performance in image recognition, classification, and prediction, the method transformed them into 2D images after noise removal and a periodic segmentation process. Further, to process data that are difficult to learn in a single network, author designed an ensemble network that relearned the excellent features extracted from each single network and applied it to a user recognition system. The performance analysis results of the proposed results show that the ensemble network exhibited a higher accuracy rate at the maximum compared to the single network. In particular, it showed a better performance that is up to 13% higher compared to the single network for the recognition rate of the classes that display the similar features, thus solving the problems occurring in a single network.

The contribution by Singh and Bhatnagar "*A Robust Blind Watermarking Framework Based on Dn Structure*", develop a robust watermarking system based on binary d-sequence and discrete cosine transform. A new concept Dn structure is employed to design the reference sets which essentially ensure the unique identification of the watermark in the extraction process. The proposed algorithm synergistically embedded watermark into the DCT domain which improved the robustness and resiliency against the various types of attacks. A detailed experimental analysis has been conducted to evaluate the performance of the scheme against a variety of attacks.

In "*A Robust Image Steganography based on the Concatenated Error Correction Encoder and Discrete Cosine Transform Coefficients*", Luo et al. developed a robust JPEG steganographic algorithm with high information extraction accuracy on resisting JPEG compression. The algorithm builds a robust virtual carrier based on the quality factor of JPEG compression in the lossy channel first. Then, a steganographic forward error correction encoder is proposed. It is concatenated by a convolutional code and a RS codes in a special designed sequence. The performance analysis shows that the proposed error correction encoder own much higher rate than the traditional encoder. The experimental results show that the technique can not only guarantee the high information extraction probability after JPEG compression, but also higher resistance to statistical detection.

In "*Effect of identity mapping, transfer learning and domain knowledge on the robustness and generalization ability of a network: A biometric based case study*", Singh and Nigam evaluated two widely validated CNN models VGG and ResNet in biometric domain. These models have shown exceptional performance on the large ImageNet dataset but the predictive capability of these models for domain specific-tasks where limited data samples are present need to be checked. Here, author analyzed two interesting biometric problems (1) multi-class oculus classification (2) fingerprint sensor classification. The experimental results are evaluated on the different benchmark datasets. Experimental results along with in-depth feature analysis have shown that indeed residual connections with pre-trained network provides good prior for model weights and thus helps in better generalization. In "*Personal Recognition using Convolutional Neural Network with ECG Coupling Image*", Pan et al. developed a personal recognition system using the 2-D coupling image of the ECG signal. The structure of the proposed system carries out preprocessing of the ECG signal through BPF, MF and R-peak detection. Then, 2-D coupling image which contains much person unique information is generated using three periods of 1-D ECG signal and the identity of a personal is

distinguished using the designed network. As a result of the experiment, the 2-D coupling image created was confirmed to be composed of an individual, unique pattern and brightness values. In addition, by using the ECG signal of the same cycle in duplicates, QRS-complex information increased, and the unique personal information became more evident, therefore, the possibility of personal recognition was confirmed using the 2-D coupling image. The accuracy, recall, precision and processing time of the proposed network were confirmed to be effective through comparison of the pre-trained network and the related work.

In "Efficient User Authentication Protocol for Distributed Multimedia Mobile Cloud Environment", Vivekanandan et al. designed a three-factor mobile user authentication protocol to access multimedia cloud services. The protocol resists with well-known attacks (informal analysis), verified using BAN logic (formal security proof) and verified using AVISPA tool (formal security analysis). Further, the proposed protocol supports additional features such as user revocation, initial user identity registration checking, user choice based service provider registration, lifetime of the secret key issued by the RC to the Ui, lifetime of the secret key issued by the RC to the CSPj, three-factor security, mutual authentication without the maintenance of server secret value, provides security to the original identity of the MUi and MBCSPj in RC and MBCSPs. It provides a robust and efficient security mechanism as well as better performance. In "Identifying Tiny Faces in Thermal Images Using Transfer Learning", Singh et al. proposed a framework for identifying tiny faces in thermal images. This was accomplished via the paradigm of transfer learning. Through testing performed in Terravic datasets, the method showed good results. In particular, Further, result showed that the framework has superior performance over existing methods in literature.

3 Conclusion

Contributions of these high quality selected articles basically reflect the new achievements in the field of for multimedia data-hiding and we hope they can provide a solid foundation for future new approaches and applications.

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