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Denoising Convolutional Neural Network Assisted Electrocardiogram Signal Watermarking for Secure Transmission in E-Healthcare Applications

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Abstract : In recent years, physiological signals obtained in telemedicine have been stored independently from patient information. In addition, people have increasingly turned to mobile devices for information on health-related topics. Major authentication and security issues may arise from this storing, degrading the reliability of diagnostics. This study introduces an approach to reversible watermarking, which ensures security by utilizing the electrocardiogram (ECG) signal as a carrier for embedding patient information. In the proposed work, Pan-Tompkins++ is employed to convert the 1D ECG signal into a 2D signal. The frequency subbands of a signal are extracted using RDWT(Redundant discrete wavelet transform), and then one of the subbands is subjected to MSVD (Multiresolution singular valued decomposition for masking. Finally, the encrypted watermark is embedded within the signal. The experimental results show that the watermarked signal obtained is indistinguishable from the original signals, ensuring the preservation of all diagnostic information. In addition, the DnCNN (Denoising convolutional neural network) concept is used to denoise the retrieved watermark for improved accuracy. The proposed ECG signal-based watermarking method is supported by experimental results and evaluations of its effectiveness. The results of the robustness tests demonstrate that the watermark is susceptible to the most prevalent watermarking attacks.

Keywords : ECG, VMD, watermarking, PanTompkins++, RDWT, DnCNN, MSVD, chaotic encryption, attacks
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