MULTI-LOSS FUNCTION IN ROBUST ATTENTION CONVOLUTIONAL AUTOENCODER FOR RECONSTRUCTION LOW-QUALITY FINGERPRINT IMAGE

Abstract

Fingerprint has been prominently used for authentication and verification of a person. The anatomical approaches are more stable and non-alterable, except by severe injury [1]. Seasonality likes low temperature and dry region commonly leads the skin become dry. As a result, even correctly touching the surface of a fingerprint sensor with your fingertip can generate a dry fingerprint. However, the COVID-19 pandemic (a coronavirus illness that broke out in 2019) has quickly grown to be a significant worldwide public health issue, which has prompted a wider use of hand sanitizers. People who are compelled to routinely wash their hands with disinfectant also get dry fingerprints [2]. This condition may affect the quality of the acquired fingerprint image even correctly touching the surface of a fingerprint sensor. When a fingerprint is imperfect, it is more difficult than when it is complete to extract the minutiae from it, and the likelihood of getting the wrong minutiae is higher.

In our research, we proposed reconstructing the incompleteness of fingerprint images based on convolutional neural network autoencoders with soft attention. We incorporate the perceptual measurement in terms of Image Quality Assessment (IQA) as the loss function to give adequate weight correction. We design the combination of several loss functions to investigate the best model, such as the multiscale structural similarity index measure (MS-SSIM), the structural similarity index measure (SSIM), and peak signal-to-noise ratio (PSNR), mean square error (MSE), and mean absolute errors (MAE). We obtain the highest image quality metric scores from the experimental result summarized as our proposed method, which is a loss function (SSIM + MSE) with optimizer Root Mean Squared Propagation (RMSProp). We evaluated the image reconstruction using 85 fingerprint images from 3 persons from Deep Learning and Media System Lab. Eventually, our proposed method gets impressive results, increasing the image's average quality by PSNR of 34.02%, SSIM of 10.13%, MSE of 64.38%, and FSIM of 10.56%. The performance is good in terms of quantitative metrics and human visual judgment. Our proposed method can be the baseline for future research to increase the performance in recognition accuracy, especially in the problem of low-quality fingerprints.

Keywords: Fingerprint Image, Reconstruction, Multi Loss Function.