World Academy of Science, Engineering and Technology
International Journal of Computer and Information Engineering
Vol:16, No:09, 2022

Optimized Deep Learning-Based Facial Emotion Recognition System

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Abstract : Facial emotion recognition (FER) system has been recently developed for more advanced computer vision applications. The ability to identify human emotions would enable smart healthcare facility to diagnose mental health illnesses (e.g., depression and stress) as well as better human social interactions with smart technologies. The FER system involves two steps: 1) face detection task and 2) facial emotion recognition task. It classifies the human expression in various categories such as angry, disgust, fear, happy, sad, surprise, and neutral. This system requires intensive research to address issues with human diversity, various unique human expressions, and variety of human facial features due to age differences. These issues generally affect the ability of the FER system to detect human emotions with high accuracy. Early stage of FER systems used simple supervised classification task algorithms like K-nearest neighbors (KNN) and artificial neural networks (ANN). These conventional FER systems have issues with low accuracy due to its inefficiency to extract significant features of several human emotions. To increase the accuracy of FER systems, deep learning (DL)-based methods, like convolutional neural networks (CNN), are proposed. These methods can find more complex features in the human face by means of the deeper connections within its architectures. However, the inference speed and computational costs of a DL-based FER system is often disregarded in exchange for higher accuracy results. To cope with this drawback, an optimized DL-based FER system is proposed in this study.An extreme version of Inception V3, known as Xception model, is leveraged by applying different network optimization methods. Specifically, network pruning and quantization are used to enable lower computational costs and reduce memory usage, respectively. To support low resource requirements, a 68-landmark face detector from Dlib is used in the early step of the FER system.Furthermore, a DL compiler is utilized to incorporate advanced optimization techniques to the Xception model to improve the inference speed of the FER system. In comparison to VGG-Net and ResNet50, the proposed optimized DL-based FER system experimentally demonstrates the objectives of the network optimization methods used. As a result, the proposed approach can be used to create an efficient and real-time FER system.

Keywords : deep learning, face detection, facial emotion recognition, network optimization methods
Conference Title : ICCV 2022 : International Conference on Computer Vision
Conference Location : Vancouver, Canada
Conference Dates : September 22-23, 2022