Performance Evaluation of Wi-Fi Based Multi-Person Interaction Datasets Using Transfer Learning

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Abstract

Wi-Fi based human activity recognition using channel state information has gained popularity due to its passive sensing capabilities, non-intrusive approach, and adequate privacy. Multi-person interactions (MPIs) recognition holds greater significance than identifying single-user activity because of its valuable insights into social dynamics. This study explores the feasibility of evaluating the performance of the MPIs datasets using transfer learning to fine-tune the pre-trained deep learning (DL) models. We utilize two pre-trained DL models, namely ResNet-50 and DenseNet-121, to evaluate the recognition performance of the MPIs datasets (Wi-MIR and Wi-HHI). The results show that the pre-trained DenseNet-121 DL model achieves 77.05% and 72.13% classification accuracy for the Wi-MIR and Wi-HHI datasets, respectively.

I. Introduction

Wi-Fi based multi-person interactions (MPIs) recognition holds significant potential and offers promising real-world applications, including healthcare monitoring, entertainment, human-computer interaction, virtual reality, and the development of smart environments [1]. However, the literature reveals [2] a predominant emphasis on identifying single-user activity, with much less focus on investigating MPIs recognition. This lack of attention on MPIs recognition is due to the complexity of analyzing interactions among multiple persons, which demands a deeper understanding of the dynamics, relationships, and various scenarios involved in MPIs. Currently, many pre-trained deep learning (DL) models are available which are designed for visual object recognition. However, this research aims to investigate the feasibility of evaluating the performance of the MPIs dataset using the concept of transfer learning to tune the pre-trained DL models.

II. MPI Recognition Models

In this paper, we select two pre-trained DL models namely ResNet-50, and DenseNet-121 and pre-trained weights of ImageNet are loaded from TensorFlow [3]. We remove the last two layers from the select models and replace two layers with the new trainable layers [2]. The overall procedure is shown in Fig. 1.

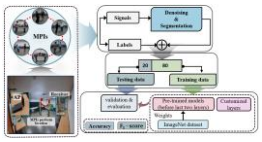

Fig. 1. Overall precedure of MPIs recognition.

III. Results

The evaluation results of the pre-trained ResNet-50, and DenseNet-121 DL models for the Wi-MIR [1] and Wi-HHI [4] datasets are tabulated in Table 1.

Table 1. Performance result for the MPIs datasets.

Dataset	Pre-trained model	Accuracy (%)	F_1-score (%)
Wi-MIR (12 class)	ResNet-50	72.85	71.27
	DenseNet-121	77.05	76.41
Wi-HHI (12 class)	ResNet-50	70.15	70.01
	DenseNet-121	72.13	71.33

IV. Conclusion

We have evaluated the performance of the MPIs datasets (Wi-MIR and Wi-HHI) using transfer learning with pre-trained DL models. However, the classification performance of the MPIs datasets can be improved by using transformer-based architectures such as vision transformer.

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