Research Article

Self-Organizing Maps Based Pattern Recognition and Image Processing for Effective Computer Vision

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ARTICLE INFO	ABSTRACT
	The application of computer vision has recently gained significant interest with SOM as a promising tool for recognizing patterns and images. In this work, the authors develop a new SOM-based framework that aims to improve the performance and robustness of important functions, including feature extraction, classification and image segmentation. Taking advantage of the feature of SOM that can map high-dimensional data to low-dimensional space while keeping the topological relation, this work redesigns the classical solutions to object detection problems, face identification, and medical image processing. The experimental results also show substantial enhancement of mean IOU and recognition rate with different sets of data. For example, for segmentation the mean precision is 85%, and for face recognition, the mean accuracy is 92%. Moreover, the applicability of the model was confirmed by applying it to the problems of handwritten digit recognition and anomaly detection demonstrating its effectiveness compared to classical methods. SOM has been shown in this work to be a highly versatile substrate with numerous applications in security/surveillance, healthcare diagnostics, and many others. However, some limitations are pointed out, including computational complexity and the sensitivity of the model to the initialization values, with recommendations to use the hybrid methodologies and optimize versions for future works. This investigation attests to SOM's applicability as the foundation of current computer vision and unlocks directions for future inquiries about SOM and deep learning along with real-time analysis. This work fills gaps in related approaches and seeks to build and strengthen paradigms for pattern recognition and image analysis in volatile environments. **Keywords:** Image Processing; Machine Learning; Pattern Recognition; Self-Organizing Maps; Unsupervised Learning.

INTRODUCTION

Hence, in the ever-developing areas of computer vision, pattern recognition, and image processing, self-organizing maps (SOM) are a reliable model. SOM, invented by Teuvo Kohonen, is an unsupervised competition that maps high-dimensional vectors into the lower dimensions where distances between the vectors are preserved while retaining the topology of the input space (Chaudhary, Bhatia, & Ahlawat, 2014; Ghrabat, Ma, Maolood, Alresheedi, & Abduljabbar, 2019; Mohialdin et al., 2024). This characteristic makes SOM particularly suitable in the various fields of image processing and pattern recognition.