Exploiting SIFT Descriptor for Rotation Invariant Convolutional Neural Network

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#172 (1570475854)

Presented by

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Introduction

- Convolutional Neural Network(CNN) is very good at learning the different kernel weights for feature extraction, but max pooling discards significant relationships among the extracted features.

- The proposed model replaces conventional pooling layer with SIFT descriptor to capture the orientation and the spatial relationship of the features extracted by convolutional layer.

Motivation

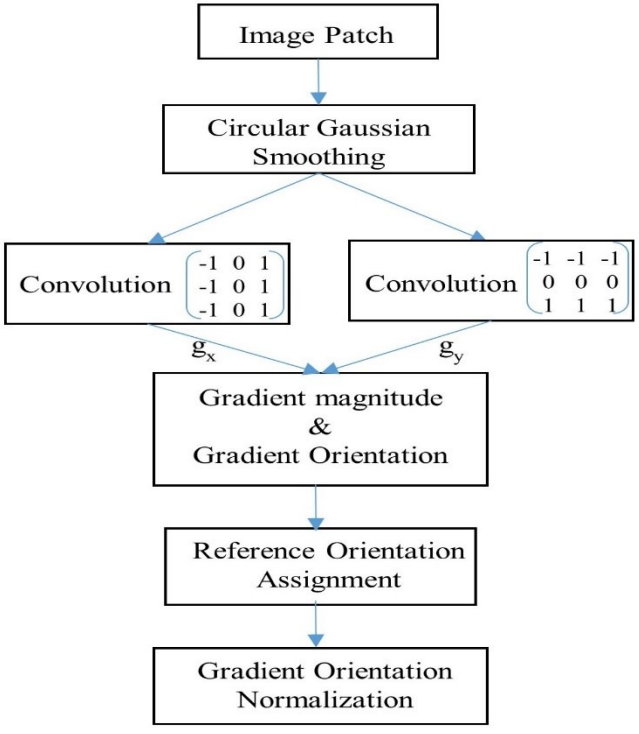
- The conventional pooling layer discards the pose, i.e., translational and rotational relationship between the low-level features, and hence unable to capture the spatial hierarchies between low and high level features.

- SIFT features are scale and rotation invariant, and hence robust to substantial range of affine distortion, change in viewpoint, illumination and noise

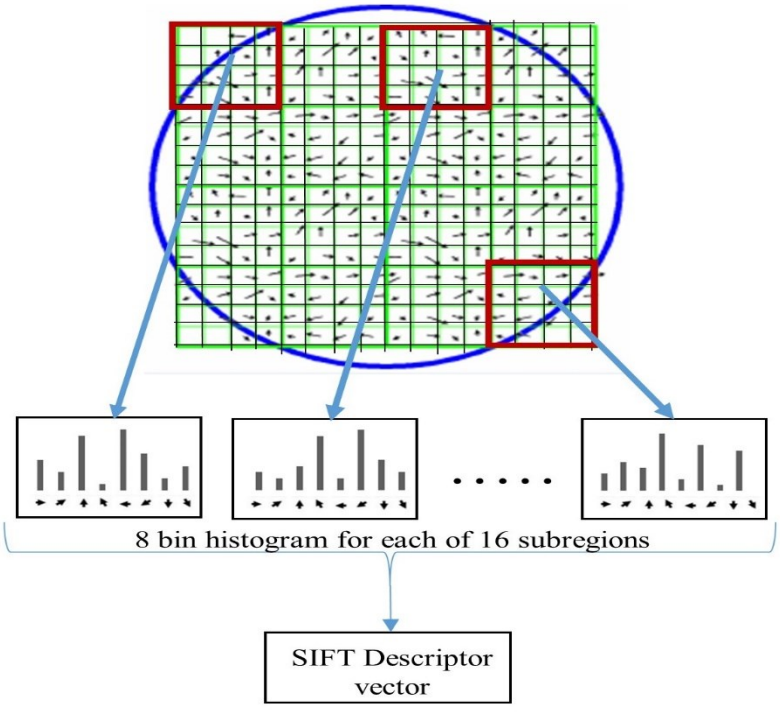
Related Works

- Lee et al [1] proposed mixed combination of average and max pooling operations.
- Zeiler et al [2] used stochastic pooling strategy.
- Williams et al [3] used wavelet pooling to decompose features
- Hinton et al [4] proposed Capsule Network (CapsNet) architecture to capture the hierarchical pose (translation and rotation) relationship.

Proposed Approach

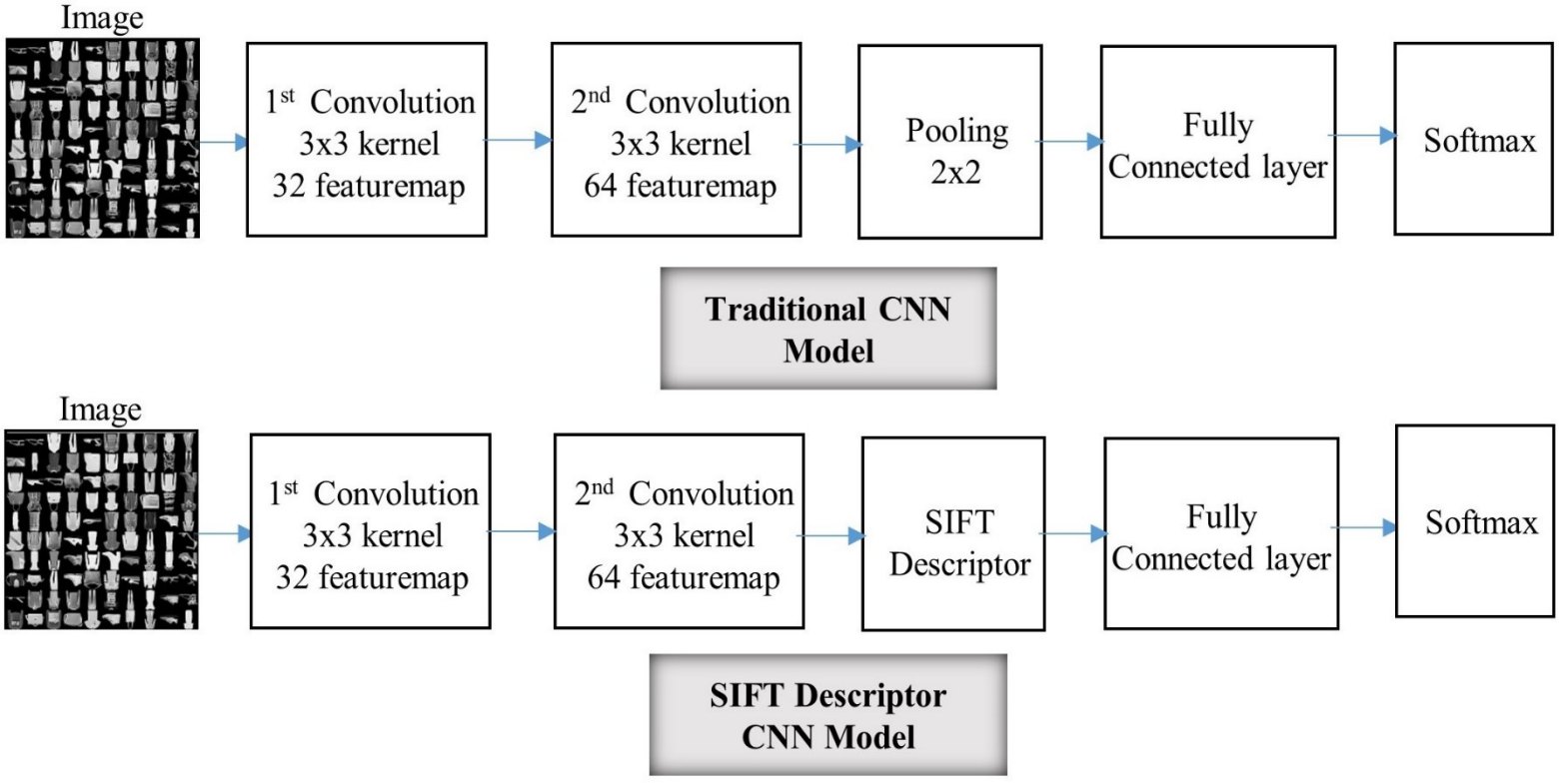


Orientation Assignment



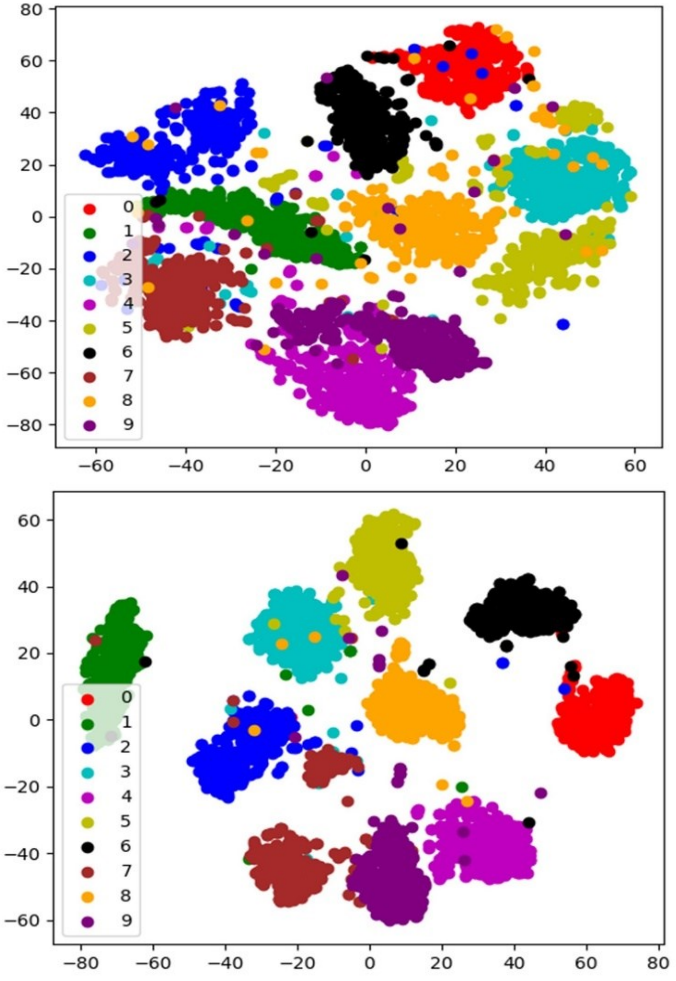
Patch Descriptor

Proposed Approach



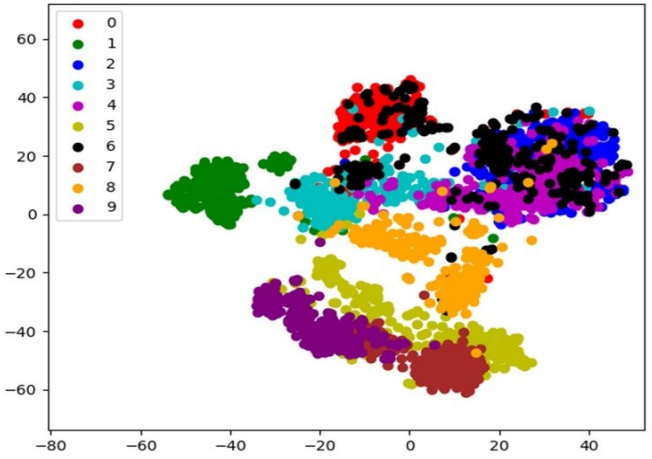
Results

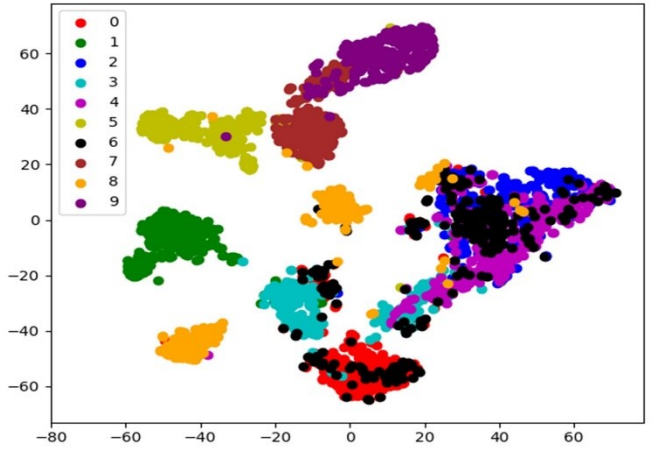
Method	Accuracy on MNIST
Max-Pooling	98.72
Average Pooling	98.80
Mixed Pooling	98.86
Stochastic Pooling	98.90
Wavelet Pooling	99.01
SIFT Descriptor	**99.56**
Hybrid max-SIFT	**99.58**



Results

Method	Accuracy on fashionMNIST
Max-Pooling	93.40
Average Pooling	93.15
Mixed Pooling	93.27
SIFT Descriptor	**93.52**
Hybrid max-SIFT	**93.47**





References

[1] C. Y. Lee, P. W. Gallagher, and Z. Tu, "Generalizing pooling functions in convolutional neural networks: Mixed, gated, and tree", in Artificial Intelligence and Statistics, 2016, pp. 464-472.

[2] M. D. Zeiler and R. Fergus, "Stochastic pooling for regularization of deep convolutional neural networks", in International Conference on Learning Representations, 2013.

[3] T. Williams and R. Li, "Wavelet Pooling for Convolutional Neural Networks", in International Conference on Learning Representations, 2018

[4] G. E. Hinton, S. Sabour, and N. Frosst, "Matrix capsules with EM routing", in 6th International Conference on Learning Representations, 2018, pp. 1-12.

Thank You

Q and A?