Depth Map Curvatures as Pose-Invariant Features for RGB-D Object Recognition

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Abstract

Computer vision tasks, such as object recognition, using deep learning find their place in a variety of contexts including agriculture. Regarding data, the coupling of RGB and depth modalities has already proven to be beneficial for object recognition over the use of RGB-only images. However, the lack of neural network architectures and large-size datasets dedicated to the depth modality forces us to use backbones pre-trained on RGB data using large datasets such as ImageNet. While works proposed by Eitel *et al.* [1] and Aakerberg *et al.* [2] rely on colorizing the depth values to match an RGB format, they do not take full advantage of the geometric properties carried by the depth modality. We demonstrated principal curvatures when used to color-encode the depth values retain more information related to the object's shape. The model's architecture is depicted in Figure 1 and the proposition was evaluated on two datasets: Washington RGB-D and a homemade synthetic dataset. With the introduction of superclasses based on the geometric shape of objects (sphere, cylinder, cube, …) from the Washington RGB-D dataset our model performed higher than the previous work, *eg. 3.1%* precision increase for the sphere superclass. Results obtained using our synthetic dataset have demonstrated the better generalization capability of our curvature-based approach. While presenting some limitations, this work opens the path for further developments.

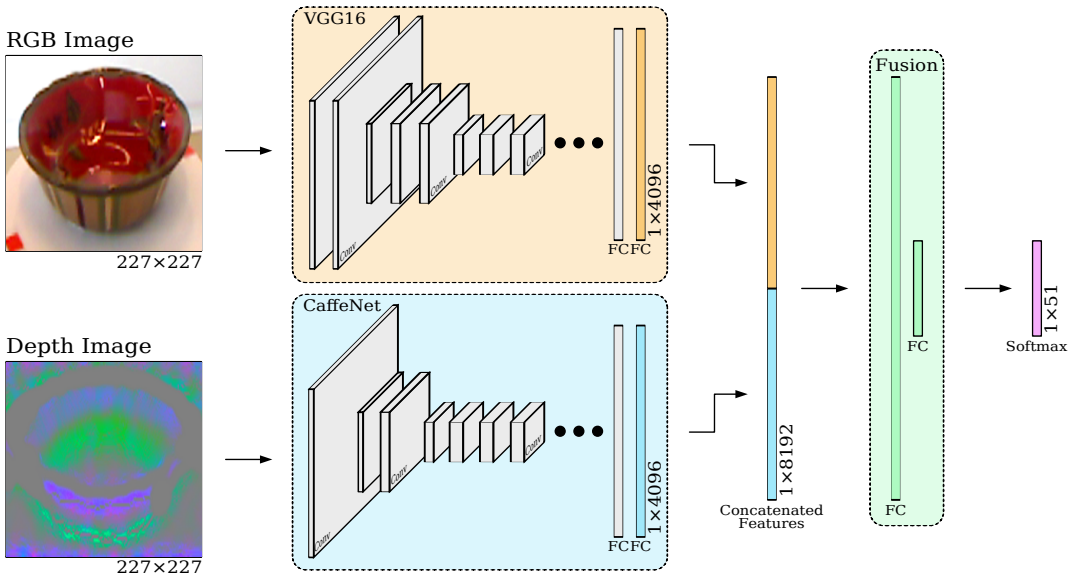

Figure 1: Simplified overview of the architecture composed of two streams. Input images have been processed using the curvature based approach.

References

[1] A. Eitel, J. T. Springenberg, L. Spinello, M. Riedmiller and W. Burgard, "Multimodal deep learning for robust RGB-D object recognition", 2015 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)

[2] A. Aakerberg, K. Nasrollahi, C. B. Rasmussen, et T. B. Moeslund, "Depth Value Pre-Processing for Accurate Transfer Learning based RGBD Object Recognition", in Proceedings of the 9th International Joint Conference on Computational Intelligence, 2017

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