Procedural 3D Object Generation for Novel Contrastive Learning in Computer Vision

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Purpose: This research aims to bridge the gap between current computer vision models and true 3D perception. Right now AI/Computer vision models are trained on a huge datasets of many objects per class, but humans don't learn this was. We see not many objects, but we see them under different conditions. By generating fewer object per classes but significantly more viewpoints per object, the project proposes a new dataset and explores whether such diversity in angles, lighting, and textures can improve contrastive learning outcomes. Rather than using typical image augmentations (color change, cropping, etc.) for Self-Supervised learning, we propose biologically plausible augmentations. Procedure: A custom pipeline was developed to procedurally create abstract, semi-abstract, and real 3D objects. For each object, an automated rendering algorithm captured multiple angles and environmental conditions. An anchor–positive–negative strategy framed contrastive training: one viewpoint of an object serving as the anchor, another viewpoint of the same object as the positive, and a different object's viewpoint as the negative. This design is intended to yield "medium" and "hard" triplets based on variations in appearance and structure. Observations/Data: The pipeline is fully operational, generating diverse triplets with multiple viewpoints for each object category. On evaluation, dataset yields on average 50%-60% accuracy Conclusions: This project outlines a flexible, scalable approach for generating procedural 3D objects and their corresponding multi-view triplets. By focusing on controllable variations in viewpoint, lighting, and texture, the pipeline offers a promise of advancing computer vision's ability to learn from richer 3D information.

Awards Won: