MACHINE LEARNING

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Professor: Travis Millburn

Name: Musani, Susendranath Reddy

TITLE: IMAGE GENERATION USING DIFFUSION PROBABILISTIC MODELS

Introduction:

This research examines the use of image processing techniques and neural network models for item recognition tasks. The offered code contains image preprocessing, autoencoder-based feature extraction, and the usage of pre-trained convolutional neural networks (CNNs) for feature extraction and similarity search.

Methodology:

Image Preprocessing: The method starts by loading images from a specified directory, resizing them to a common size (32x32 pixels), and normalizing the pixel values. Two sets of pictures are generated for training and testing purposes.

Autoencoder-based Feature Extraction: TensorFlow Keras is used to develop an autoencoder neural network. This network is made up of convolutional and upsampling layers, which encode and decode picture characteristics, respectively. The autoencoder is trained on the training data to produce a compact representation of the input images.

Image Similarity Search: After training the autoencoder, the encoder component generates encoded representations of images from the test set. Cosine similarity is then determined between a selected image and all other images in the test set using their encoded representations. The most similar photographs are gathered and shown.

Pre-trained CNN for feature extraction: In addition, a pre-trained InceptionV3 model is used to extract features from photos. These attributes are then utilized to calculate cosine similarity and identify similar photos in the test set.

Results:

The autoencoder-based approach is successful in learning a compressed representation of the input images. Visual assessment of the reconstructed images shows that, despite the lossy compression, the model captures essential information.
Image Similarity Search: Using the encoded representations from the autoencoder, similar images are found using cosine similarity. The recovered images are visually similar to the query image, confirming the autoencoder's efficacy in feature extraction.

Pre-trained CNN Approach: Feature extraction using the InceptionV3 model also produces good results. Similar photos are effectively identified using cosine similarity derived from extracted features, demonstrating the effectiveness of transfer learning in image recognition tasks.

Conclusion:

The methodologies used illustrate effective approaches to image preprocessing, feature extraction, and similarity search in object identification tasks. The autoencoder-based technique provides a lightweight solution for feature extraction, whilst pre-trained CNNs deliver cutting-edge performance with minimal customisation. Further investigation and optimization may improve the performance of these strategies in real-world applications.

Recommendations:

Experiment with different topologies and hyperparameters for the autoencoder to increase feature extraction accuracy.
To improve performance, experiment with alternative pre-trained CNN models and feature extraction fine-tuning procedures.
To measure generalization capabilities, apply the implemented algorithms to larger datasets and various object categories.