~ Project Proposal ~
Image Super-Resolution Using Convolutional Neural Networks (CNNs) in MATLAB.

Group 25
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Overview

Image Super-Resolution (ISR) is a critical technology in various fields such as medical/satellite imaging, and security surveillance, where high-resolution images are crucial for accurate analysis and decision-making. The objective of this project is to develop a system that can enhance the resolution of low-quality images using Convolutional Neural Networks (CNNs) in MATLAB. The project will involve training a deep learning model to learn the mapping from low-resolution (LR) to high-resolution (HR) images, leveraging CNNs' ability to capture intricate image details and structures [1].

Goals

1. Develop a CNN-based model for image super-resolution.
2. Enhance the quality and resolution of low-resolution images.
3. Compare the performance of the CNN-based model with traditional interpolation methods.

Methodology:

Data Preparation:

- Obtain a high-quality dataset of paired LR and HR images.
- Preprocess the images by normalizing and resizing them to a consistent size.
- Split the dataset into training, validation, and test sets [2].

Model Design:

- Design a CNN architecture tailored for super-resolution.
- Use layers such as convolutional layers, ReLU activation layers, and batch normalization layers.

Training & Evaluation:

- Train the CNN model using the prepared dataset.
- Implement data augmentation techniques to enhance model robustness.
- Evaluate the trained model on the test set using metrics such as Peak Signal-to-Noise Ratio (PSNR) and Structure Similarity Index (SSIM) [3].
- Compare the CNN-based model's performance with traditional methods like bicubic interpolation.

Feasibility analysis:

- MATLAB provides robust tools and functions for deep learning and image processing, ensuring the technical feasibility of the project.
- Pre-trained models can accelerate the training process and improve model performance.
- The focus will be on core functionalities such as model training, evaluation, and comprehensive documentation, ensuring the project can be completed within the timeframe.

Milestones (and Job Partitions):

Week 1-2:

- Research on image super-resolution techniques and CNN architectures [1]. (All)
- Dataset acquisition and preprocessing. (Jake, Rodrigo)
- Design and implementation of the CNN architecture. (Ethan, Jake)

Week 3-4:

- Initial model training with a small subset of data for quick iteration and debugging. (Ethan, Rodrigo)
- Implement data augmentation techniques. (All)

Week 5:

- Model evaluation using PSNR and SSIM metrics. (Jake, Ethan)
- Comparison with traditional interpolation methods. (Rodrigo)
- Documentation and preparation of the final report and presentation. (All)

References:

[1] C. Dong, C. C. Loy, K. He, and X. Tang, "Image Super-Resolution Using Deep Convolutional Networks," in IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 38, no. 2, pp. 295-307, Feb. 2016, doi: 10.1109/TPAMI.2015.2439281.

[2] E. Agustsson and R. Timofte, "NTIRE 2017 Challenge on Single Image Super-Resolution: Dataset and Study," in Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition Workshops (CVPRW), 2017, pp. 1122-1131, doi: 10.1109/CVPRW.2017.150.

[3] Z. Wang, A. C. Bovik, H. R. Sheikh, and E. P. Simoncelli, "Image Quality Assessment: From Error Visibility to Structural Similarity," in IEEE Transactions on Image Processing, vol. 13, no. 4, pp. 600-612, Apr. 2004, doi: 10.1109/TIP.2003.819861.