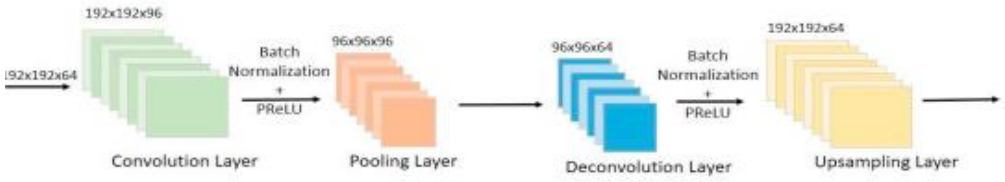
Autoencoders Based Deep Learner for Image Denoising

Nowadays, digital images have a valuable role in our daily life, and can be used for various of applications like fingerprint recognition, video surveillance etc. Sometimes, images get infected with noise due to many reasons such as defects in camera sensors, transmission in noisy channel, faulty memory locations in the hardware etc. Processing a noisy image is not advisable because usually it yields erroneous outcomes. So, as to improve it for subsequence processing, the noise must be eliminated from the image in advance. Therefore, there is a need of an efficient image denoising technique that helps to deal with noisy image. Image denoising is a process to realign the original image from the degraded image. In this paper, autoencoders based deep learning model is proposed for image denoising. The autoencoders learns noise from the training images and then try to eliminate the noise for novel image. The experimental outcomes prove that this proposed model for PSNR has achieved higher result compared to the conventional models. This paper uses the concept of autoencoder for removing the Gaussian noise from the degraded image. An autoencoder is a type of artificial neural network that aims to learn a representation (encoding) for a set of data. It is the autoencoder that learns noise from training images and then tries to generate a clean image very close to its original input. This autoencoder based proposed model uses convolutional layer and deconvolution layer to defuse the noise. At last, peak signal to noise ratio (PSNR) and Structural Similarity Index (SSIM) are used to measure the performance of this proposed model.

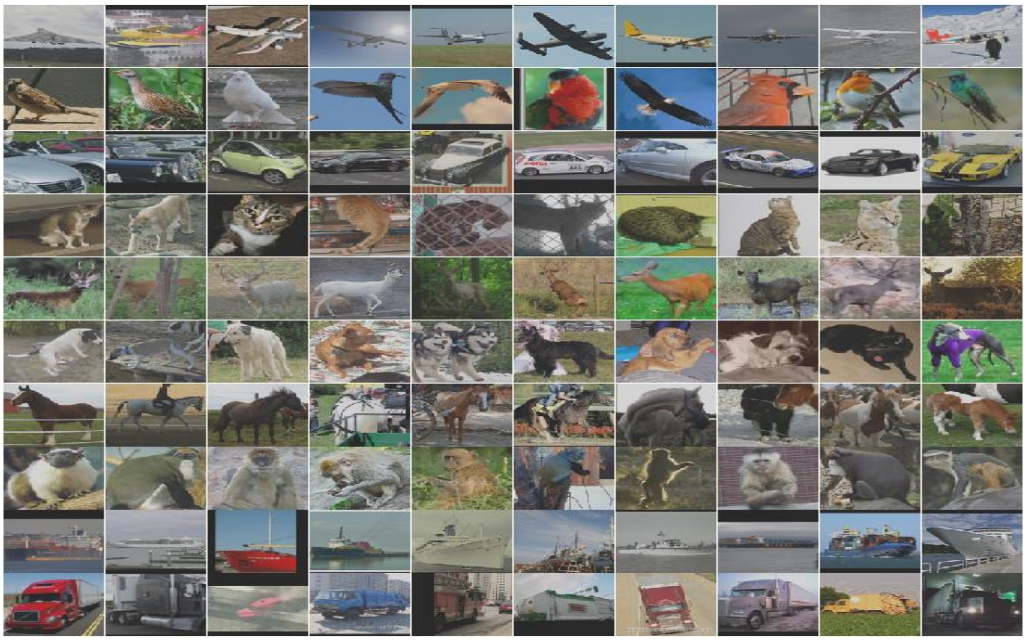
Network Architecture

architecture is briefly described, which takes degraded image as input and produces clean enhanced image as output. This model mainly consists of input layer, convolutional layers, deconvolution layer and output layer. The CDA block includes four internal layers, named as convolution layer, pooling layer, deconvolution layer and upsampling layer. In this model, the batch normalization and Parametric Rectified Linear Unit (PRelu) activation function are deployed between convolution layer and pooling layer, and deconvolution layer and upsampling layer respectively. The output of CDA is connected with its input. The convolution layers are connected here to upsampling layers by direct connections. This helps in speeding up the process of learning.



Dataset

STL-10 dataset is used to train this proposed model. It is a image recognition dataset and it can be used for self taught learning algorithms, deep learning and unsupervised feature learning. This dataset contains 3 categories like training image set, testing image set and unlabeled image set. The training and testing image sets contain 5000 images and 8000 images respectively. The unlabelled image set contains 100000 unlabelled images, which are used for unsupervised learning. Each image is 96X96 pixels in size. This proposed denoising network used unsupervised learning based model. To train the model, 40000 unlabelled images are used for training and validation purpose.



As performance metrics, PSNR (peak signal to noise ratio) and SSIM (structural similarity Index) are used to measure the performance of the proposed system, which are shown in equation 1, 2 and 3. The PSNR evaluates the peak signal to noise ratio value between the original image and the reconstructed image, where high PSNR value indicates good quality of the reconstructed image. SSIM is used to measure the perceptual difference between the original image and the reconstructed/cleaned image, where the SSIM value ’1’ indicates that the original image is identical to the reconstruction image and ’< 1’ indicates that the original image is far from reconstructed image. The result of the experiment shows that our proposed model has performed better than conventional technologies in terms of PSNR.