Amazon Bin Image Dataset

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Background

I used the Amazon Bin Image Dataset(ABID) at Open Data on AWS. It contains 536,434 images and metadata from bins of a pod in an operating Amazon Fulfillment Center. I'm interested in the problem of counting the number of items in each bin (1 - 5 items). There are several challenges. First, the images are noisy: white tape in the foreground often blocks the view of items inside. Second, counting by image classification (classes 1-5) is difficult because there are 460,512 unique items. Third, counting by object detection is not possible because the metadata does not contain annotated locations nor classes. I wanted to find a way to improve model performance.

Objectives

Remove foreground tape from the images, then train the model on the cleaner images to see if it improves classification performance.

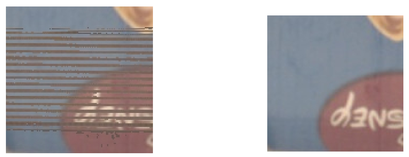
Tech Stack

Keras, TensorFlow, Amazon Machine Learning + Amazon EC2, GIMP, scikit-image image processing in python, python, NumPy

Methods

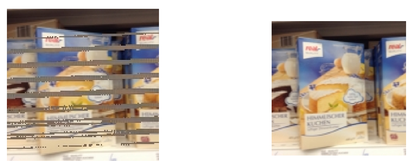
Construct a tape / no tape datasets to train a "de-taping" autoencoder. This no tape/tape datasets was constructed from non-taped section in the ABID, an additional grocery items dataset, and synthetically created tape noise applied over the clean images.

Original Bin Images



Denoise Datasets 1

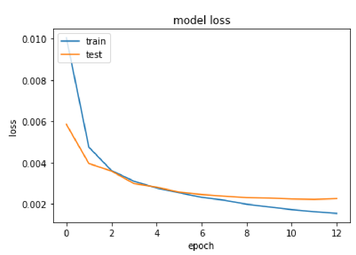
X: tape noise image **Y: no tape image**



Denoise Datasets 2

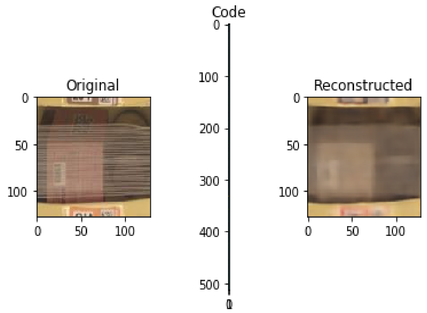
Measures

Loss plot for Autoencoder

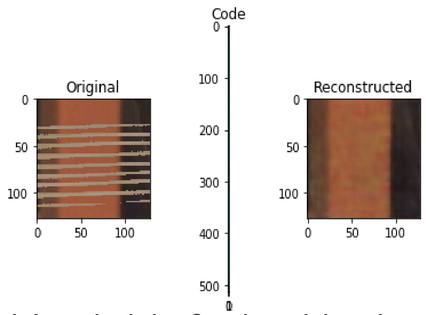


Results

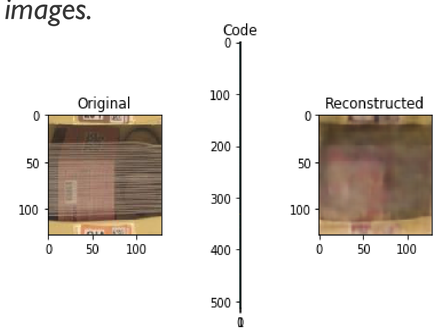
First, I trained the autoencoder model for reconstruction of the original bin images.



Second, I retrained the decoder model for removing white tape noises.



Third, I applied the fitted model to the original bin images.



Fourth, I used encoder feature extraction model to predict the number of items in each bin.

Conclusion

The autoencoder was able to reconstruct the original image and the denoise autoencoder removed tape noise in datasets 1 and datasets2.

The same model for datasets 1 could be able to remove some noise from the original bin images, but the loss in image quality gets notable after the effect. The model for datasets 2 did not generalize the denoise effects.

Discussion

Loss Function for Autoencoder

Binary Cross Entropy produce a slightly better result for the reconstruction autoencoder compared with Mean Square Error. However, it did not give the same benefit for the denoising.

Counting object by Image Classification

How can we train the model to count objects without the annotation?

References

Abid Challege:
https://github.com/silverbottlep/abid_challenge/tree/master/counting

Image Classifier:
https://github.com/dandresky/inventory-classifier

Amaon Inventory reconciliation Using AI.
http://cs229.stanford.edu/proj2018/report/65.pdf