Computer Vision in Convenience Retail

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The Images

Scraped from the web

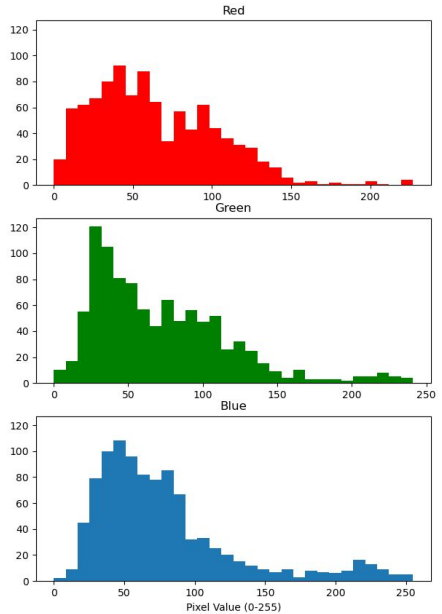
Labeled Data

ice cream

cigarettes

EDA

Histograms of RGB



EDA

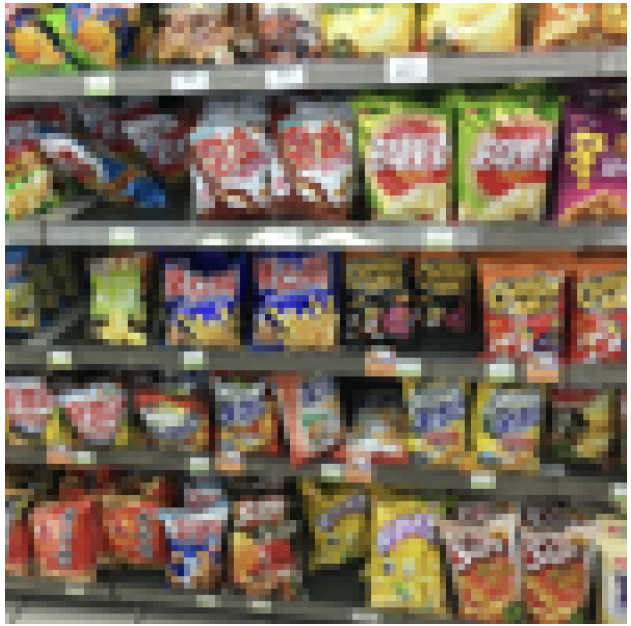
Observe the difference

in image features of

1600 x 1600 vs

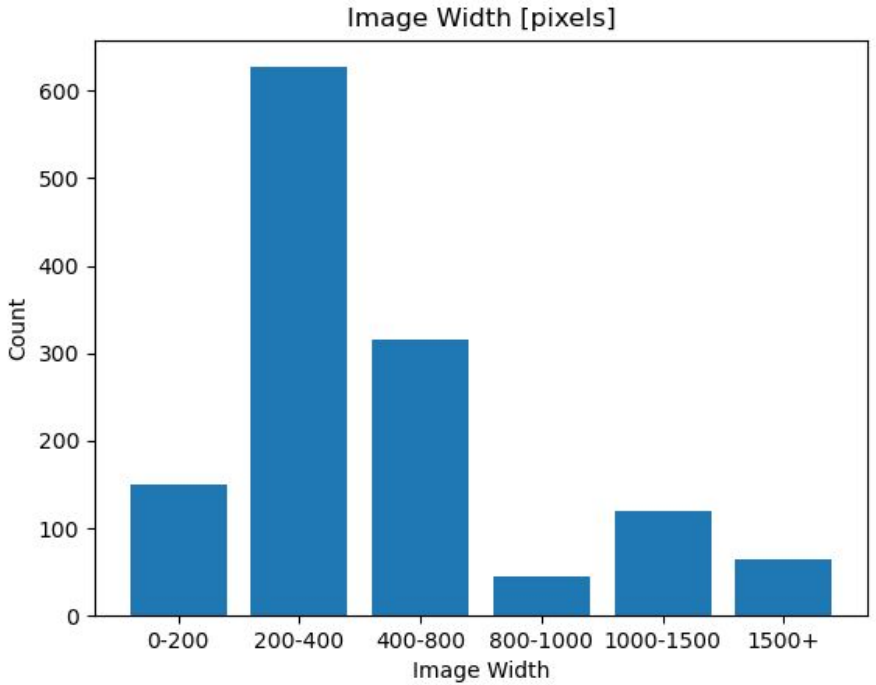
100 x 100 image

```
tensor([[[255, 210, 213,  ..., 217, 215, 200],
         [252, 205, 213,  ..., 217, 216, 210],
         [232, 203, 213,  ..., 209, 208, 213],
         ...,
         [190, 191, 191,  ..., 181, 181, 181],
         [191, 191, 191,  ..., 181, 181, 181],
         [191, 191, 191,  ..., 181, 180, 180]],

        [[178, 103,  90,  ..., 166, 168, 153],
         [154,  91,  86,  ..., 163, 165, 159],
         [120,  77,  78,  ..., 150, 152, 157],
         ...,
         [193, 194, 194,  ..., 176, 176, 176],
         [194, 194, 194,  ..., 176, 176, 176],
         [194, 194, 194,  ..., 176, 175, 175]],

        [[190, 113,  95,  ...,  61,  54,  35],
         [167, 101,  93,  ...,  63,  58,  50],
         [136,  91,  85,  ...,  58,  57,  62],
         ...,
         [176, 177, 177,  ..., 136, 136, 136],
         [177, 177, 177,  ..., 136, 136, 136],
         [177, 177, 177,  ..., 136, 135, 135]]]
```



EDA

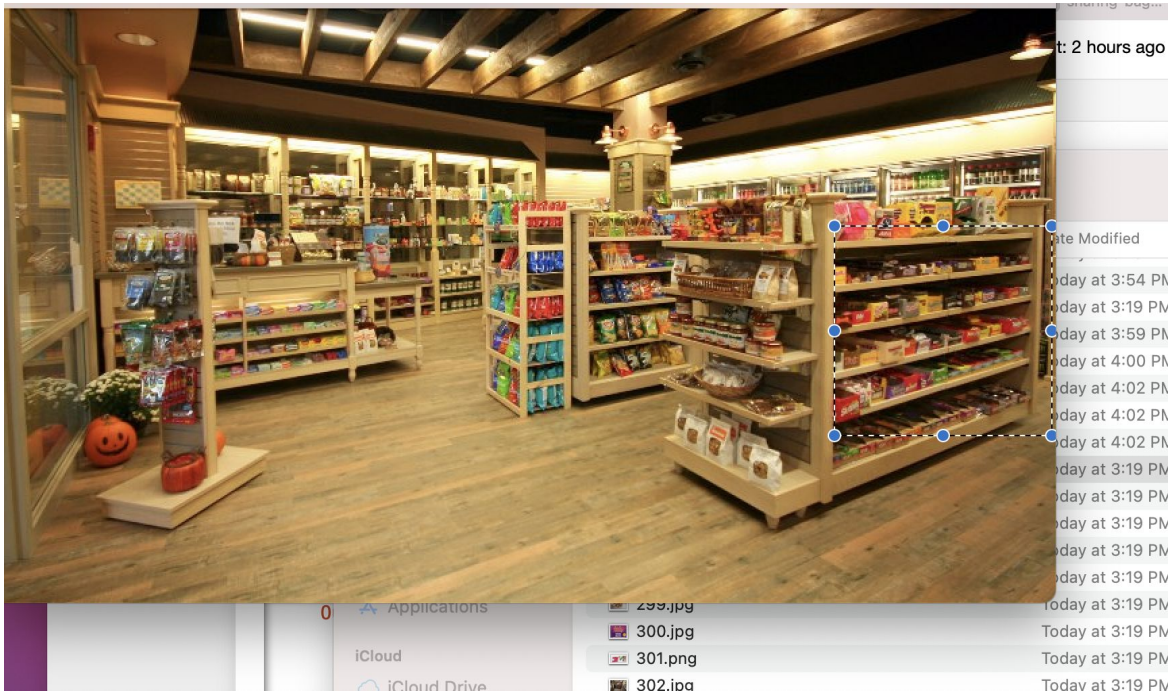
224 x 224 images are the most common

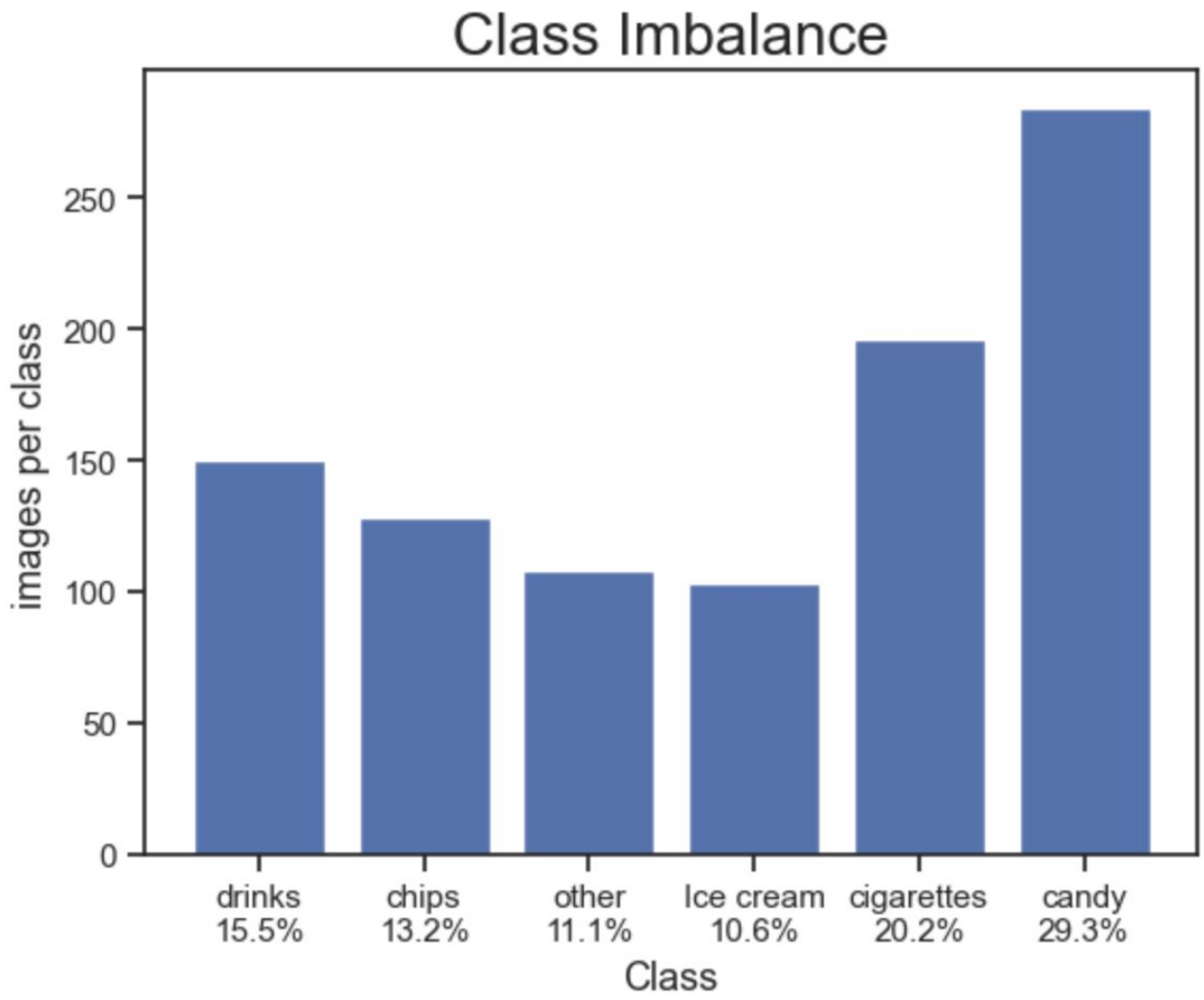


Cropping an image

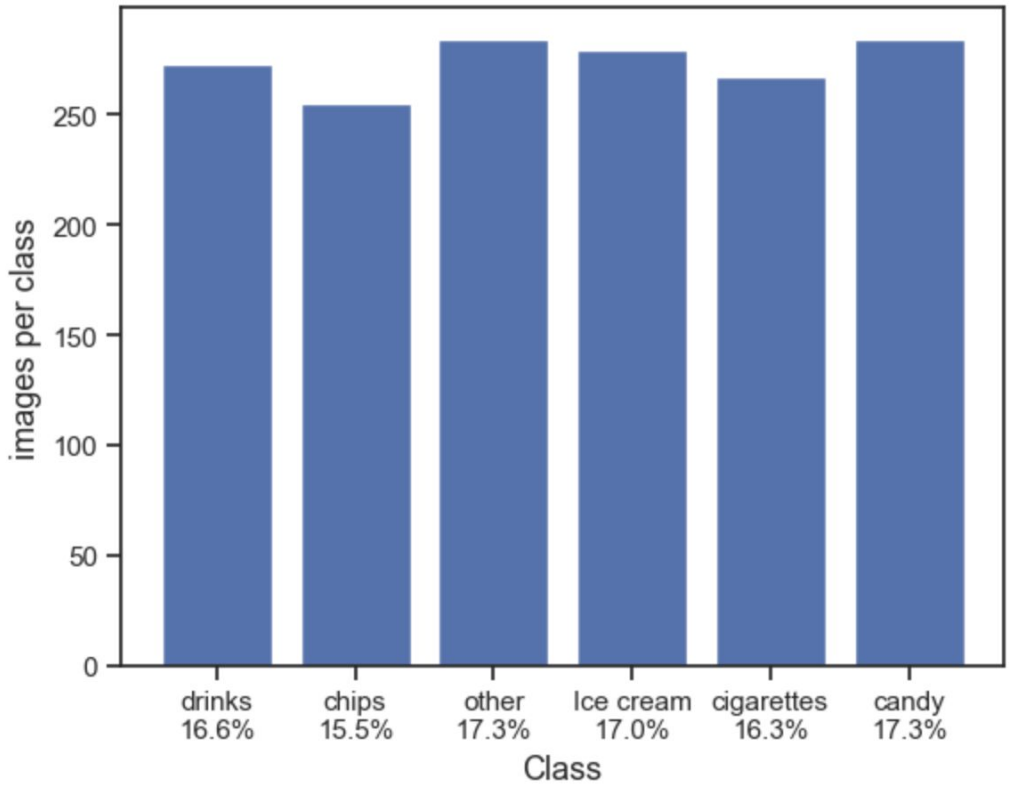
Cropped Image

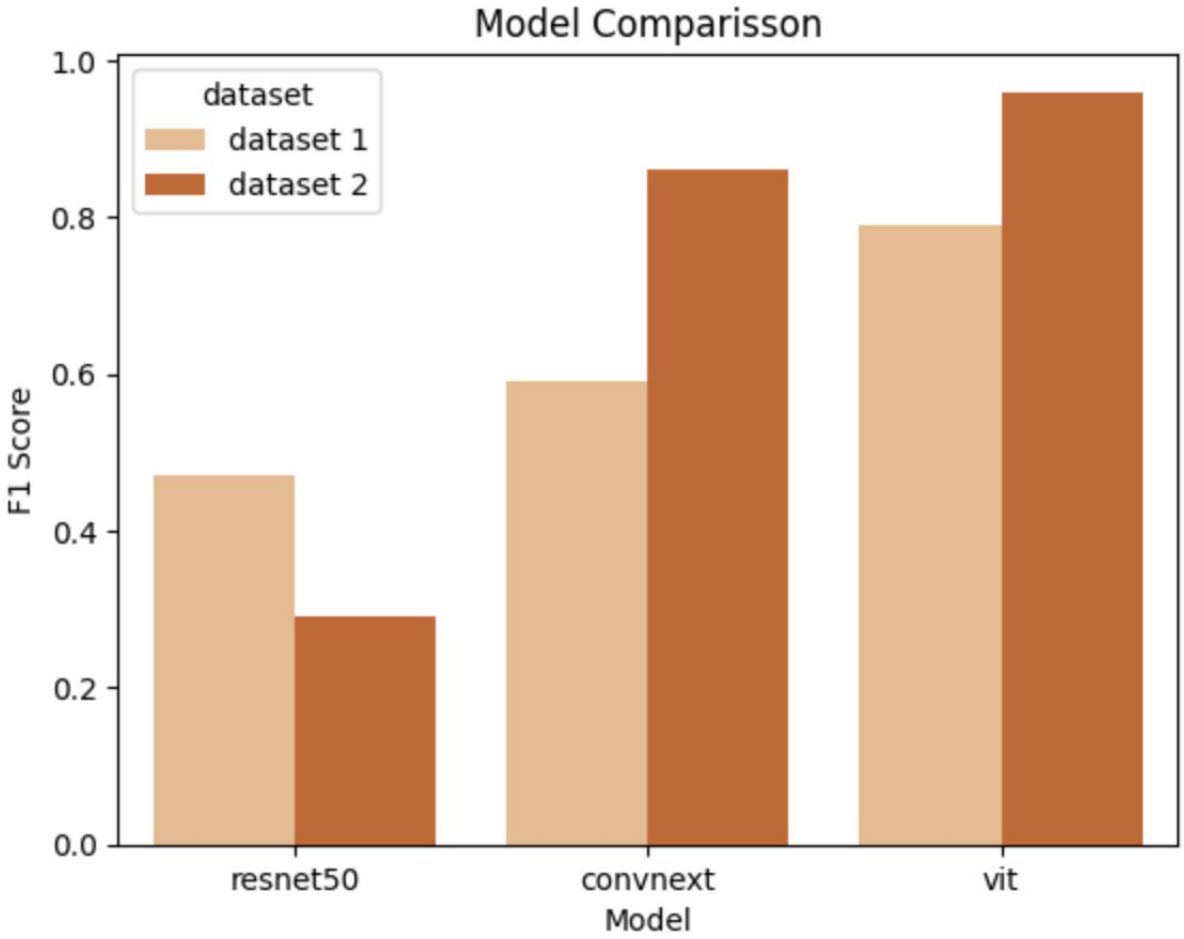
Image Data Wrangling - manual cropping of images




Class Imbalance
images per class
0
50
100
150
200
250
drinks
15.5%
chips
13.2%
other
11.1%
Ice cream
10.6%
cigarettes
20.2%
candy
29.3%
Class

The final dataset - 1,321 images




Model Comparisson
dataset
dataset 1
dataset 2
1.0
0.8
0.6
0.4
0.2
0.0
F1 Score
resnet50
convnext
vit
Model

Model results

model	accuracy	precision	recall	f-1score
ResNet50	0.33	0.44	0.22	0.29
ConvNeXt	0.85	0.84	0.9	0.86
ViT	0.95	0.94	0.92	0.96

Conclusions

- Outstanding results achieved with a small image dataset
- ViT Transformer model can classify six merchandise categories with an accuracy of 95%.
    - This is testament to the robustness of the Transformer architecture

- Further work: Develop a segmentation model that can detect inventory in images and out-of-stocks. This model could then be deployed to perform ordering and inventory management functions

Recommendations for the Client

- Deploy the model onto a web-based platform so that merchandisers in the field can utilize the application
- Fine-tune the pretrained model further on proprietary company merchandise photos
- Add more images and categories to the model like Paper Products, Grocery, Health & Beauty Care, etc.
- Test the model on images of merchandise in convenience and retail stores to verify 95% accuracy of model