Retail product classification

L. A. Budimir, K. Tolja, S. Lončarić, M. Subašić and Z. Kalafatić

e-mail: lovre-antonio.budimir@fer.hr, katarina.tolja@fer.hr

Image Processing Group

Faculty of Electrical Engineering and Computing, University of Zagreb

1. Introduction

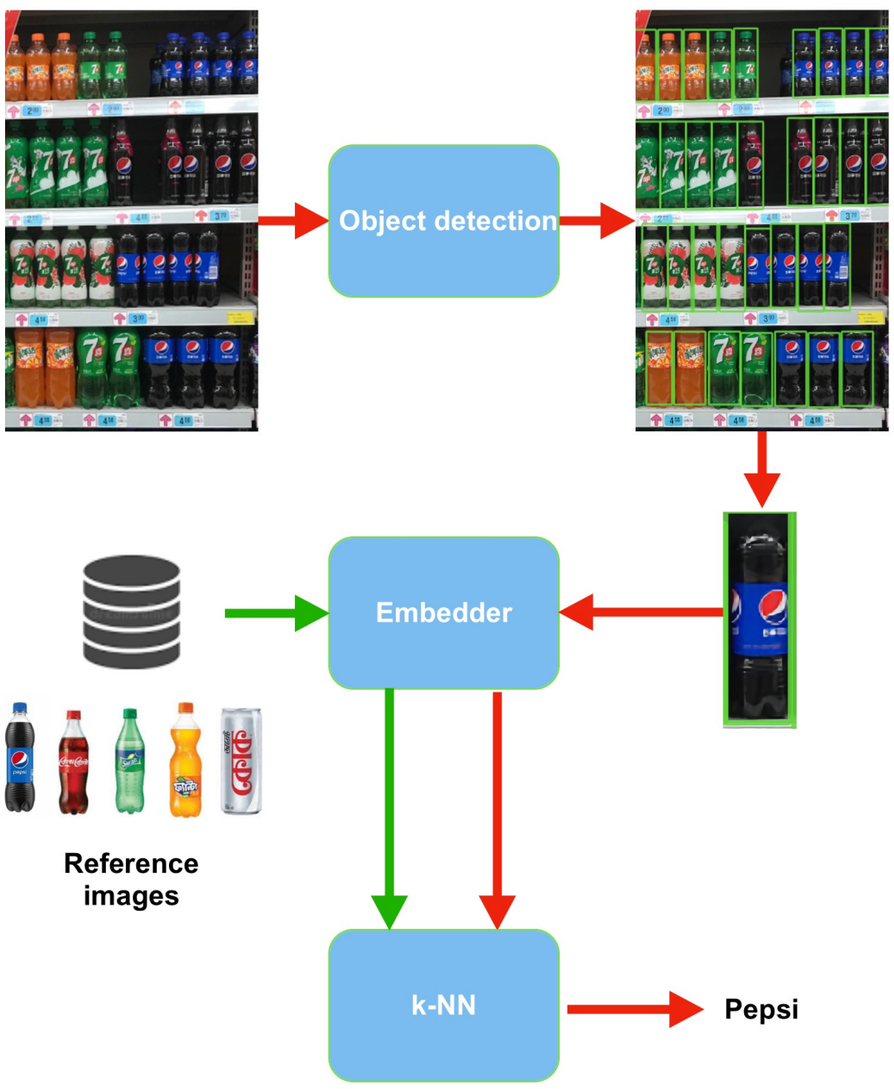
Automated retail product recognition from the store shelves could benefit customers and retailers. Applications may include helping visually impaired customers find products, assisting retailers in managing real-time inventory, and planogram compliance.

2. Problem description

Product recognition is a large-scale classification problem because one store can display several thousand different products on its shelves. Furthermore, retail stores can add or remove new products daily. The product recognition algorithm must also distinguish minor labels and packaging differences between products from the same category or distributor. Product size classification is a challenging computer vision problem due to the inter-class similarity between product sizes, poor image resolution, a single image containing multiple classes, parts of the product that are not visible and angular images. The main issue is that images aren't captured from the same distance. In addition, they do not contain any reference objects.

2. Product classification

Identifying products on store shelves is a more challenging task than the one on which classic state-of-the-art architectures in object localization and recognition have been evaluated. In order to combat the lack of data for training, a very large number of classes, and constant changes in the store, systems for localization and recognition of products on the shelves need to be implemented with the help of few-shot learning algorithms where CNNs are used as feature extractors of retail products images.



Product recognition pipeline

3. Product size classification

Product size classification will be concentrated on bottles. As all bottles have caps of approximately the same sizes, caps could be used to determine bottle sizes. The idea is based on cap and bottle size measurements, eg. width, height, and surface ratio.

Euclidean Distance Based Ratio (cap Vs whole bottle height)

Firstly, the task is to detect all bottles from the shelf, which can be a problem on its own. Secondly, cropped bottles received from bottle detection are forwarded to cap detection. Later ,with postprocessing and classification, bottles are classified to appropriate classes. YOLOv5 object detector is used for both detection tasks.

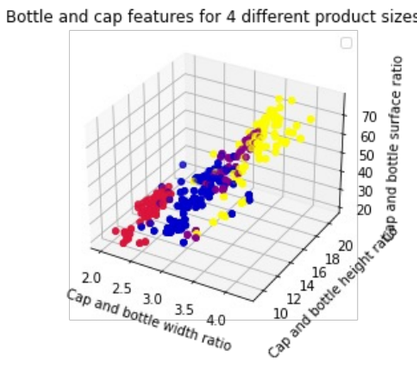
Bottle size classification based on cap and bottle feature ratio

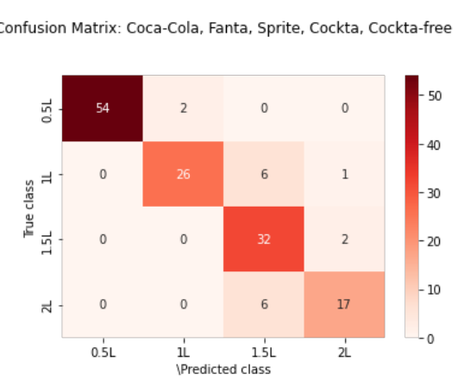
4. Results

The traditional softmax loss separates features from different classes, but struggles at reducing intra-class variability. Several methods for metric learning based on the softmax loss are tested on RP2K dataset to see their performance on the problem of product classification.

Loss function	m	s	Accuracy
Softmax loss			92.97%
Normalized version of softmax loss [48]		64	95.77%
Additive Margin Softmax Loss [50]	0.35	64	**95.82%**
Additive Angular Margin Loss [51]	0.35	64	95.71%

Product size classification requires a thorough analysis of feature ratios. As can be seen from the scatterplot, features expectedly separate bottle classes. The confusion matrix of bottle classes confirms this theory.





5. Conclusion

This poster presented a method for identifying products on shelves and a specialized method for determining product size when this is not possible with the help of classic classification methods.

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