EE P 596 A Project: Pull your shelf together

Team: Rishabh Gupta, Sreejith S.

PROBLEM STATEMENT

We propose a methodology for automatically identifying product misplacement on the shelves of a supermarket.

We aim to provide the following functionalities. The system should:

1. Be able to detect and classify a range of products.
2. Be able to identify a misplaced product.
3. Provide location information for the misplaced product.

Stretch Goal:

1. Detect out-of-stock products.

PROBLEM RELEVANCE

With a humongous increase in product categories, the logistics of creating a good product placement has become taxing for the staff in supermarkets. Moving the misplaced products to their correct position adds to the time and effort of the employees. This translates to huge inefficiencies and is a precursor to monetary losses and poor customer service.

Our methodology will help the staff to automatically identify misplaced products instead of manually perusing through each item within the shelves. This will speed-up correct product placement on shelves, allowing the staff more time to focus on helping and guiding the customers.

W

RELATED WORK AND PRIOR ART

Traditional techniques for shelf digitization utilize local invariant features and the technique of sub-graph isomorphism between the items appearing in the given shelf and the ideal shelf layout [4].

Modern techniques utilize the power of deep learning to understand spatial information within the shelves. Yilmazer and Biranttackle [3] use deep learning architecture (YOLOv4) to monitor OSA (On Shelf Availability). They solve the annotation problem by proposing a new method that combines the two concepts of "semi-supervised learning" and "on-shelf availability" (SOSA).

Initiatives like Amazon Go have fusion sensors, proximity sensors, and LIDAR scanners to identify misplaced items on a shelf in case image recognition systems fail esp. when light conditions are inadequate [5].

OUR PLANNED METHOD

Our goal is to perform product classification and detection in a grocery mall setup. We aim to identify misplaced products to save time and effort for the employees. It would also help customers find desired products with ease.

We plan to implement the product position outlier detection over images in the Grocery dataset [1] through the following steps:

1. Product classification and detection are performed using the Detectron2 library [2].
2. We then identify misplaced products based on their nearest product neighbors and using a distance threshold.
3. (**Stretch goal**) We identify different kinds of gaps (Separation gaps and product gaps). We utilize the information about the product gaps to detect out-of-stock items.

As the future scope, product detection can be made over a live video. Additional functionalities like suggesting the correct placement location of the product, keeping a count of the inventory etc., can be added to the system.

W

REFERENCES

[1]G. Varol, "Grocery Dataset," GitHub, Nov. 30, 2021. https://github.com/gulvarol/grocerydataset (accessed Dec. 01, 2021).

[2]"Detectron2: A PyTorch-based modular object detection library," ai.facebook.com. https://ai.facebook.com/blog/-detectron2-a-pytorch-based-modular-object-detection-library-/.

[3]R. Yilmazer and D. Birant, "Shelf Auditing Based on Image Classification Using Semi-Supervised Deep Learning to Increase On-Shelf Availability in Grocery Stores," Sensors, vol. 21, no. 2, p. 327, Jan. 2021, doi: 10.3390/s21020327.

[4]A. Tonioni and L. Di Stefano, "Product Recognition in Store Shelves as a Sub-Graph Isomorphism Problem," Springer Link, 2017. https://link.springer.com/chapter/10.1007%2F978-3-319-68560-1_61 (accessed Dec. 01, 2021).

[5]R. Gross, "How the Amazon Go Store's AI Works," Jun. 07,2019. https://towardsdatascience.com/how-the-amazon-go-store-works-a-deep-dive-3fde9d9939e9.

W