PROJECT PROPOSAL

Inventory Monitoring at Distribution Centers

Amazon Bin Image Dataset

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Domain Background

Inventories are the foundation of a successful and functioning e-commerce company. To ensure the continuity of a business and its supply chain, it therefore becomes key to manage its inventory with maximum optimization. Inventory management has a direct impact on the financial performance and growth of an e-commerce business.

Relevant Statistics

1) Warehouse space in the United States costs about $5.08 per square foot[1]
2) American retailers carry about $1.43 in inventory for every $1 of sales[1]

Additionally, such warehouses and distribution centers require constant monitoring to improve their efficiency whether manual or automated. Retail/e-commerce companies frequently struggle with order mix-ups, dead stock issues, insufficient stock levels, and warehouse disorder. In certain cases, inventory maintenance also poses blockers such as staff safety as evidenced by the COVID pandemic, with staff having to work just to maintain a normal supply chain.

Automating inventory management thus becomes key for any major company to optimize their cash flows. In lieu of this, distribution centers use robots to move objects as a part of their operations. Objects are carried in bins which can contain multiple objects. Computer Vision intelligence inbuilt in such robots can help enhance the efficiency of such systems.

Problem Statement

The problem statement for this project is :

“Identify the number of objects in an Amazon delivery package(bin)”

Automatically detecting the number of objects can be used to track inventory and make sure that delivery consignments have the correct number of items.

Datasets and Inputs

The Amazon Bin Image Dataset contains over 500,000 images and metadata from bins of a pod in an operating Amazon Fulfillment Center. The bin images in this dataset are captured as robot units carry pods as part of normal Amazon Fulfillment Center operations[3].

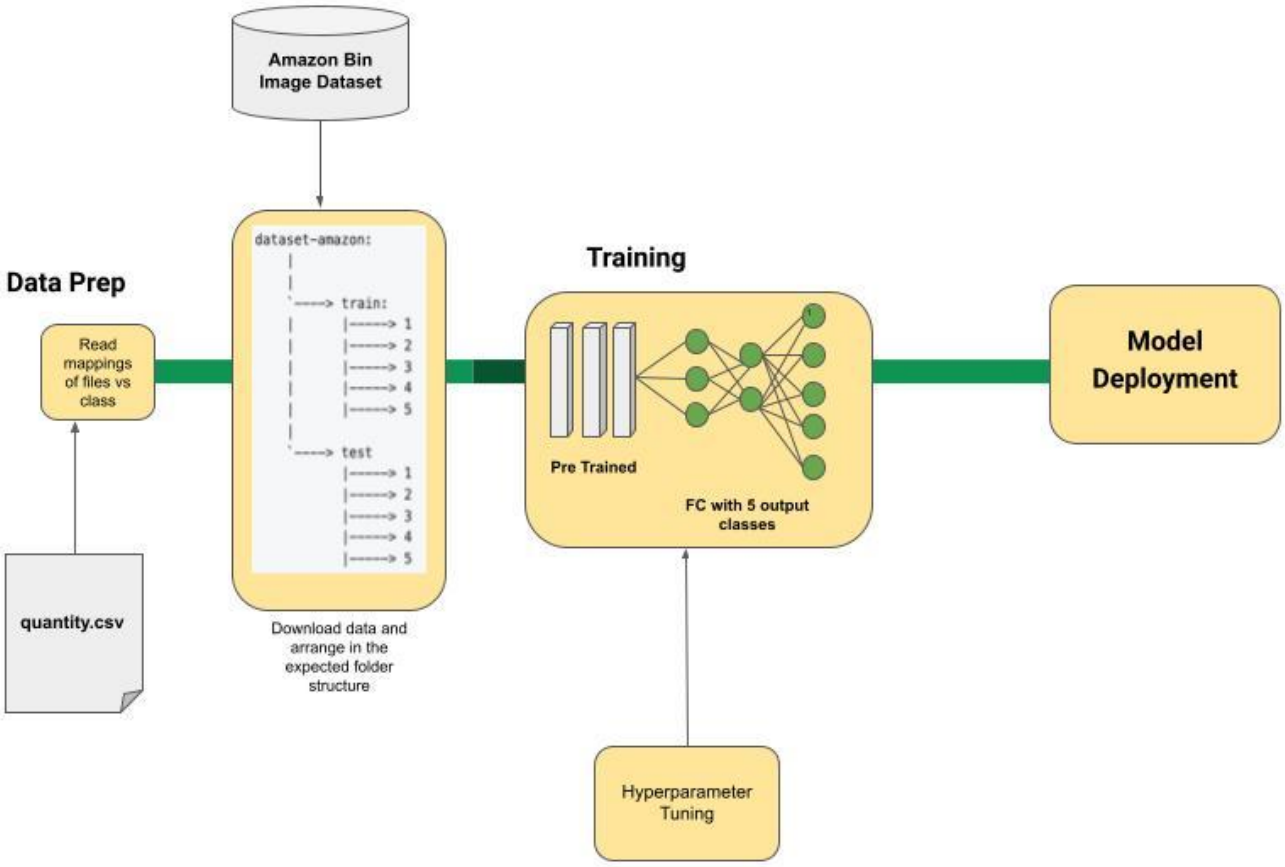
An additional input file containing mappings of the image filenames and corresponding number of objects within the bin image is also used from here. This file will come in handy if training is done in increments of dataset size, thus trying to obtain the highest classification accuracy using the minimum number of images.

Solution Statement

The above problem statement can be solved using a Computer Vision Deep Learning Model. Moreover, existing pre-trained models like VGG-16, Resnet-18, Resnet-50, InceptionV3, Xception etc. can be used to reduce training time and costs.

For this project, the Resnet-50 model is chosen as the optimal model as it generates models of size in the range of ~100MBs, owing to actual model weights size which is smaller as it uses global max pooling.[2] This also, contributes to its accelerated speed of training

Project Design



Benchmark Model

The selected resnet50 model trained on the given dataset against sample hyperparameters(epochs: 5, learning rate: 0.7) with no data augmentation or preprocessing techniques used will be marked as the benchmark against which further improvements are attempted.

Evaluation Metrics

The evaluation metric used to gauge the performance of the model is Accuracy.

$$Accuracy = \frac{Number\ of\ correctly\ predicted\ images}{Total\ number\ of\ images}$$

Image created using Online Free LaTex Editor[4]

Since an equal number of images are available within each class of our training dataset, it can be concluded that the dataset is balanced. Accuracy is a useful and meaningful metric when the target class is well balanced.

Citations

[1]https://www.upkeep.com/what-is-inventory-management

[2]https://analyticsindiamag.com/a-comparison-of-4-popular-transfer-learning-models/

[3]https://registry.opendata.aws/amazon-bin-imagery/

[4]https://www.tutorialspoint.com/online_latex_editor.php

References

https://stackoverflow.com/questions/59201907/overfitting-on-image-classification