Inventory Monitoring at Distribution Centers (Project Proposal)

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1. Domain Background:

The complexity and speed requirements of logistics tasks are constantly increasing. Product identification and traceability are increasingly important necessities for many modern producers. Goods are printed, marked, engraved, etched, or labeled with various barcodes, characters, and symbols to identify contents and provide vital manufacturing information. In addition, more and more goods need to be unpacked, inspected, packaged, and distributed in an ever shorter time.

Modern image processing software provides all the necessary methods and technologies for reading characters, codes, and symbols, regardless of how they were applied. Objects can also be identified entirely without codes by visual texture features and color, for example.

Many processes in logistics and warehouse automation can benefit from the use of computer vision. Warehouse processes can be partially and fully automated with computer vision systems.

The scope of this project would focus on a single branch of inventory monitoring which is to automate the process that ensures that every bin contains the correct number of products.

2. Problem Statement:

With the rising cost (salaries, operation cost, human errors) of the workforce that is required for manual inventory management comes the need for more effective and cost-optimized inventory management methods.

Inventory management automation would eliminate a lot of human-related costs (operation/error costs) and one of the most state-of-the-art used techniques in Inventory management automation is Computer vision.

Computer vision enables real-time data collection via images and video collected by drones, phones, robots, and fixed cameras on shelves, in stores, and in warehouses. Computer vision-enabled software tracks stock detects damaged or mislabeled items, analyzes and forecasts peak- and off-peak demand for particular items and stores, and even orders products from suppliers.

For years, computer vision has been transforming business solutions across industries, from self-driving cars to healthcare. Advances in this kind of artificial intelligence, which relies on machine learning (ML) models for object detection and recognition, have made computer vision competitive with human vision.

3. Solution Statement:

As stated before we will use computer vision to help automate the count of the products in each bin.

In this project, we will fine-tune a pre-trained CNN model to produce a robust model that can choose the count of items in each pin by looking at its image.

Project Component:

Dataset or the Image Source

The Amazon Bin Image Dataset is to be used to train the model. It 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 carrying pods as part of normal Amazon Fulfillment Center operations.

Documentation about the open source dataset can be found here. These are some typical images in the dataset. A bin contains multiple object categories and a various number of instances.

The corresponding metadata exists for each bin image and it includes the object category identification(Amazon Standard Identification Number, ASIN), quantity, size of objects, weights, and so on. The size of bins varies depending on the size of objects in them. The tapes in front of the bins are for preventing the items from falling out of the bins and sometimes it might make the objects unclear. Objects are sometimes heavily occluded by other objects or limited viewpoints of the images.

Algorithm

We will fine-tune the Resnet50 pretraind CNN. The model hyperparameters will also be tuned to find out the best hyperparameters.

Environment or the platform

We are going to use the AWS platform (Sagemaker - S3).

4. Benchmark Model:

The result of the Amazon Bin Image Dataset (ABID) Challenge will be considered a Benchmark. The author has achieved an accuracy of approximately 55%. This project will try to achieve or exceed this mark.

5. Evaluation Metrics:

The overall **accuracy** of the classification can be used to evaluate the performance of the trained model.

6. Evaluation Metrics: