AWS MACHINE LEARNING ENGINEER NANODEGREE

Capstone Project Proposal - Inventory Monitoring at Distribution Centers

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Domain Background

Distribution centers have a lot of repetitive processes in their daily operation, nowadays, a lot of these processes have been automated with AI and robotics. A lot of operations using robotics need to feed the robot's logic with information about its surroundings, it can be done using computer vision algorithms such as Convolutional Neural Networks (CNN). This project is about a computer vision solution to help robots successfully achieve their daily tasks.

Problem Statement

Robots in a distribution center need to move bins with items from one place to another, for example, robots move items to set up the inventory in warehouses. Usually, these moving operations are achieved using bins, the robot needs to know how many items each bin has to keep count of the number of items moved. It is difficult to equip a moving robot with the necessary technology to make this counting process accurate and affordable, but, considering that we live in the technology revolution, another solution can be to use an external system that does this counting job, maybe with an image of the bins' content.

Solution Statement

The most feasible solution to this problem is to equip the robot with a camera that focuses on the bins' content and sends the image to a system that does the job. This outsourced system has to be equipped with the necessary AI to identify how many items a bin has by using only an image of the bin's content. This AI will be CNN which needs to be trained with hundreds or even thousands of labeled images. In this project, we want to train and deploy a model for helping the robots within a distribution center to identify how many items are in a bin's photo.

Datasets and inputs

The dataset for developing this project is the Amazon Bin Image Dataset which contains 500.000 images of bins containing one or more products, it also has a metadata file for each image which contains information about the number of objects in the bin, their dimensions, and type. We need to work with a subset of this dataset to prevent any excess in SageMaker credit usage.

Benchmark Model

After looking for possible solutions to the problem in internet forums, I have found that a lot of people recommend using a pre-trained YOLO model and replacing the final layer with a classification layer of N classes, then, using the classification as the number of items in an image (1-N possible). In this project, we are going to set N to the maximal number of items a bin can have, it can be established after pre-processing the data.

Evaluation Metrics

Because we see this problem as a classification problem, a valid metric could be the accuracy of the model.

Project Design

Next, we can see the steps needed to conclude this project:

1. Get a subset of the data from the source and store it in an S3 bucket.
2. Pre-process the data and prepare the train and test labeled datasets, then, store it in S3.
3. Build the training script to finetune a CNN pre-trained model, also build the necessary code to submit training jobs in SageMaker.
4. Finetune a CNN pre-trained model with the labeled data using hyperparameter tuning in SageMaker.
5. Check the performance of the type of instances used for training using SageMaker profiling, if needed suggest a cheaper instance to further training.
6. Deploy the model to an endpoint.
7. Encapsulate the endpoint functionality into a lambda function.
8. Simulate high throughput to set concurrency and auto-scaling capabilities to the endpoint.