AWS Machine Learning Engineer Nano degree Capstone Proposal – Inventory Monitoring at a Distribution Center

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March 22nd, 2023

Domain Background

Most e-commerce brands, wholesaler and retailers need to keep track of thier inventory. This has not always been easy in the past but these days with there are technologies, systems and processes that help companies to manage thier supply chain. Inventory control systems are used by most companies to keep track of thier inventory. These systems are important because they help to keep track of a companies inventory levels in one warehouse or in warehouse spread across several locations. An important part of the inventory control system is inventory monitoring which is how we keep track of physical inventory. Machine learning provides a way to improve the accuracy of inventory monitoring through the use of image recognition and image classification. This project aims to implement an inventory monitoring system that uses Machine learning.

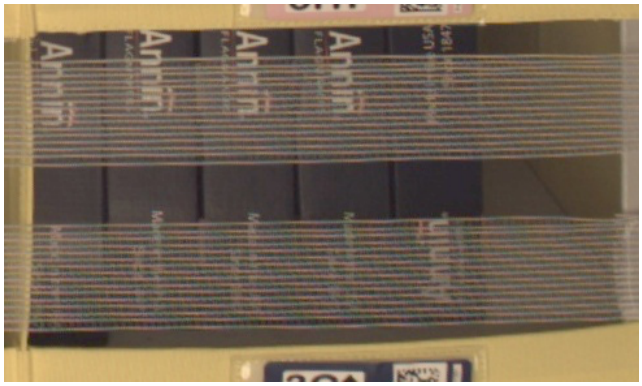
Problem statement

At Amazon distribution centres, robots are often used to move objects around as part of the operations. Objects are moved around in bins which can hold multiple objects. This project aims to build a model that can count the number of objects in each bin. When the model is integrated with the system, it will help to track inventory and make sure that delivery consignments have the correct number of items. The efficiency of this solution can be evaluated using metrics such as accuracy, F1 score etc. This makes the solution measurable. We can measure the efficiency by measuring the quantity of the goods handled per day.

Datasets and Inputs

The amazon bin image dataset [1] was used to train the model. The dataset contains about 500000 images and metadata from bins of a pod in an operating amazon Fulfillment Center. The images in the data set were captured while robots carried around pods during the operations in an amazon fulfillment center. A subset of the dataset will be used. It will be divided into the test, training and validation set. The dataset will be saved in an S3 bucket from where it will be used.

Sample images from the data set :-



Each of the image comes with a metadata that contains the number of objects in the image, the class labels for each object and the dimensions of the object.

Below you will find a sample of the metadata.


```
{
    "BIN_FCSKU_DATA": {
        "B00CFQWRPS": {
            "asin": "B00CFQWRPS",
            "height": {
                "unit": "IN",
                "value": 2.399999997552
            },
            "length": {
                "unit": "IN",
                "value": 8.199999991636
            },
            "name": "Fleet Saline Enema, 7.8 Ounce (Pack of 3)",
            "normalizedName": "(Pack of 3) Fleet Saline Enema, 7.8 Ounce",
            "quantity": 1,
            "weight": {
                "unit": "pounds",
                "value": 1.8999999999999997
            },
            "width": {
                "unit": "IN",
                "value": 7.199999992656
            }
        },
        "ZZXI0WUSIB": {
            "asin": "B00T0BUKW8",
            "height": {
                "unit": "IN",
                "value": 3.99999999592
            },
            "length": {
                "unit": "IN",
                "value": 7.899999991942001
            },
            "name": "Kirkland Signature Premium Chunk Chicken Breast Packed in Water, 12.5 Ounce, 6 Count",
            "normalizedName": "Kirkland Signature Premium Chunk Chicken Breast Packed in Water, 12.5 Ounce, 6 Count",
            "quantity": 1,
            "weight": {
                "unit": "pounds",
                "value": 5.7
            },
            "width": {
                "unit": "IN",
                "value": 6.49999999337
            }
        },
        "ZZXVVS669V": {
            "asin": "B00C3WXJHY",
            "height": {
                "unit": "IN",
                "value": 4.330708657
            },
            "length": {
                "unit": "IN",
                "value": 11.1417322721
            },
            "name": "Play-Doh Sweet Shoppe Ice Cream Sundae Cart Playset",
            "normalizedName": "Play-Doh Sweet Shoppe Ice Cream Sundae Cart Playset",
            "quantity": 1,
            "weight": {
                "unit": "pounds",
                "value": 1.4109440759087915
            },
            "width": {
                "unit": "IN",
                "value": 9.448818888
            }
        }
    },
    "EXPECTED_QUANTITY": 3
}
```


Labelled caption https://github.com/silverbottlep/abid_challenge

It can be seen that the “EXPECTED_QUANTITY” attribute contains the value that represents the number of objects in a bin.

Solution statement

As stated earlier this problem is viewed as an image classification problem. The solution will use a pre-trained(Resnet 50) deep learning model. The model will be trained using the images from the amazon bin imagedata. The input that is feed to the model is an image of the bin which contains a number of objects. The output should be a predicted score list for number of objects in the bin. The model will be trained using SageMaker Studio and the hyperparameters tuned with SageMaker's hyperparameter tuning. The model will be evaluated using accuracy as a metric. The trained model will be deployed and tested against a test set to see how it performs.

Benchmark Model

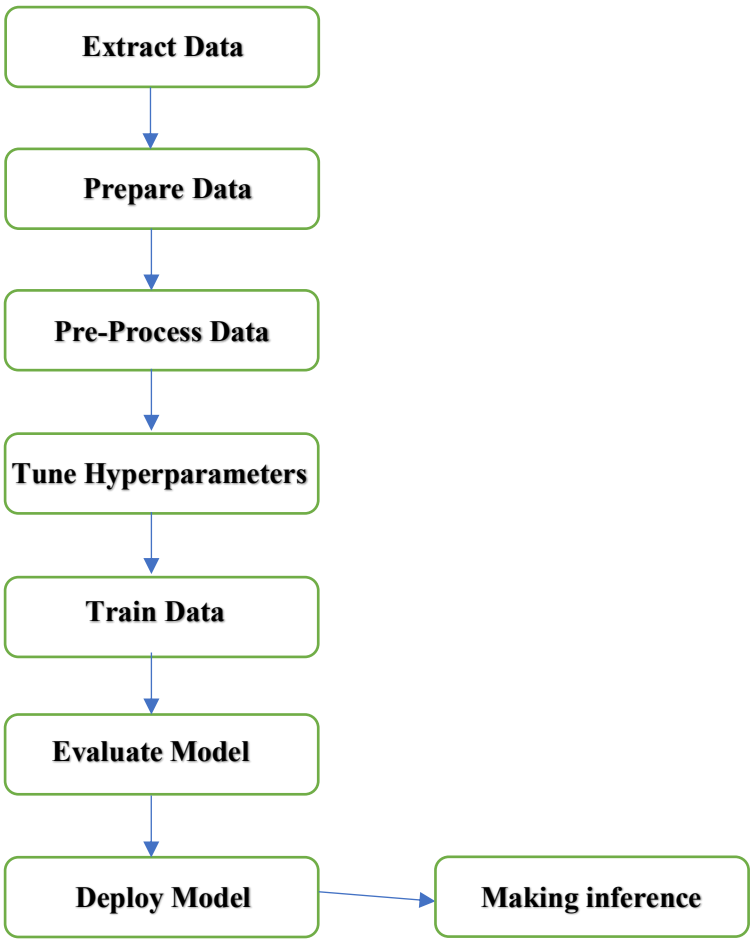
The project will be benched marked using accuracy since it is a classification problem. The aim is to get an accuracy of above 55.67% which is the accepted value in the Amazon Bin image dataset challenge [2]. The benchmark model will be a ResNet-50 Architecture that will be trained on the dataset.

Evaluation Metrics

As stated, this is a classification problem, Classification problems are usually evaluated using accuracy as a metric.

Project Design

Below is a high-level proposed solution to the inventory monitoring problem.



References

[1] - *Amazon Bin Image Dataset - Registry of Open Data on AWS*. (n.d.). Amazon. https://registry.opendata.aws/amazon-bin-imagery/

[2] - S. (n.d.). *GitHub - silverbottlep/abid_challenge: Amazon Bin Image Dataset Challenge*. GitHub. https://github.com/silverbottlep/abid_challenge