Robotic Inference Project

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Abstract—Achieved the required accuracy for the supplied images captured over the conveyor belt by using the AlexNet neural network. Produced meaningful results for the chosen Robotic Inference idea of classifying three classes of objects(Kitchen Items, Foot wear, Toys) using the AlexNet neural network.

Index Terms—Robot, AlexNet, Udacity, Inference, deep learning.

1 Introduction

TRYING to build a model to recognize the real world objects. Using DIGITS workspace trained a model to recognize written numbers. Here built two models, one to recognize the moving objects on the conveyor belt and other to recognize the objects in the real world objects in a typical home which is the inference idea. This inference idea stemmed out of the need to organize the objects in home, where a considerable amount of time is spent daily to organize the things like the Kitchen items after cooking, organize the toys after the kids play and organize the foot wear left at the entrance once entered into home. Basically want to build a model for "Robotic Maid". Based on the previous experiences in the Follow Me project and the exercises to recognize the written numbers, built inference model using the AlexNet with tuned hyper parameters.

2 Background / Formulation

For both the models, used the AlexNet with different set of parameters. Tuned the parameters based on the experience of the previous Follow Me Project and achieved required results with below parameter values. As the AlexNet is the most popular and worked on this network in previous projects, built the model on this network, but before that tried the GoogleNet, but it is taking more time to train the model and accuracy is also not good, it has fallen down. So in the interest of the time resorted to the AlexNet and achieved good results than the required.

TABLE 1
Supplied DataSet

Supplied DataSet of Images Parameters
Learning rate .001
Batch size of images : 64
Epochs : 20

Got an accuracy of 98 percent and predicted the 3 classes objects correctly with below parameters.

3 Data Acquisition

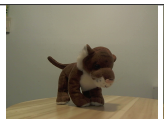
For the first requirement of project to recognize the objects on the conveyor belt, used the provided images. For the second requirement of project to recognize the chosen inference idea, collected the images using a web cam through a python program to automatically label them. The images are with a size of 640px height and 480px width in RGB color. Captured around 30 images for each object with a total of 300 images for each class (classes:Kitchen items, Foot wear, toys).

TABLE 2
Robotic Inference Project

Robotic Inference Project - Parameters
Epochs : 20
Batch size : 64
Learning rate : 0.005

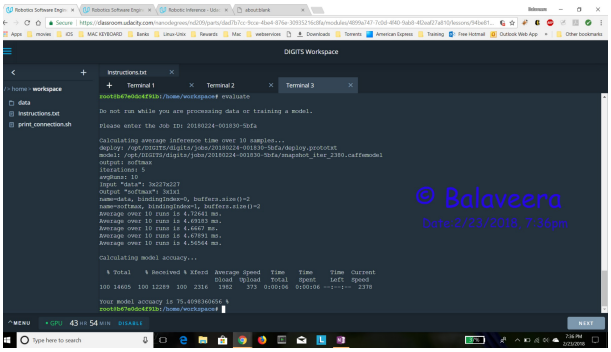
Refer below for the sample images from the inference project.

TABLE 3
Table

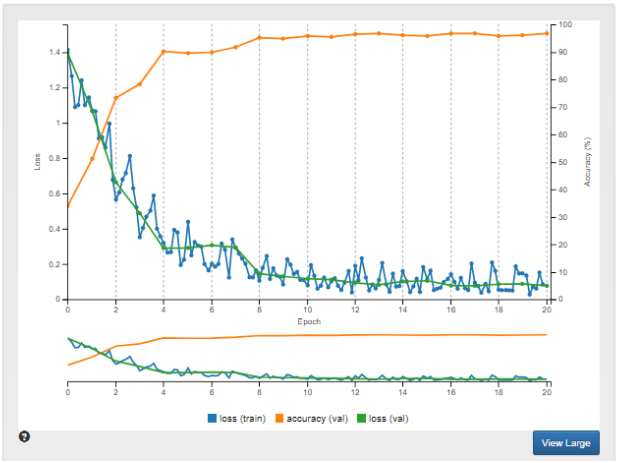
Kitchen Item		
Toy		
Foot wear		

4 Results

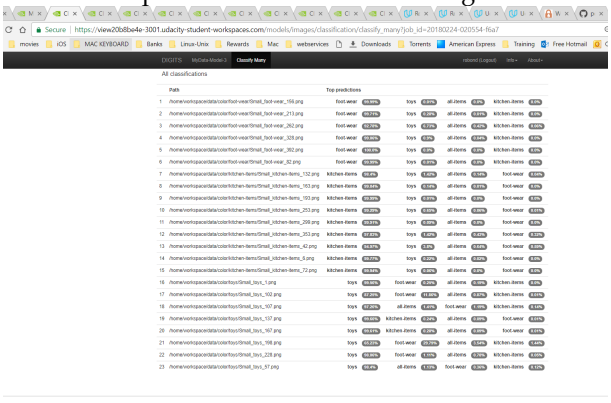
Achieved the results with the required accuracy. Below image is the results for the first requirement to achieve 75 percent accuracy and an inference time of less than 10 ms. Achieved the accuracy of 75 percent with an inference of 6ms Please refer to the below image



For the reference model, achieved a 90+ accuracy while training the model and below is the graph for the same.



The model was able to predict objects correctly with a minimum of 87 percent and below is the image for the same.



5 Discussion

For both the models, used the AlexNet with different set of parameters. Tuned the parameters based on the experience of the previous Follow Me Project. Tuned the parameters gradually to achieve more than 75 percent accuracy and less than 10ms of inference as it is clear that accuracy and inference are like two eyes, if accuracy is not good, the model will fail in recognizing the objects and if the inference is more, then it will take time to do the work. First started with parameters in the Table 4 (Trail -1) , got the accuracy of 50+ percent, but it is recognizing some of the kitchen items to foot-wear and most of the toys to foot-wear, then increased the epochs to 20 as in Table 5 (Train - 2), still the same situation then increased the learning rate to 0.005 as in Table 6 (Train -3) and predictions are correct with an accuracy of 75+ percent. Refer to the Table 7 for Trail -1 and Trail -2 prediction results and for Trail -3 prediction refer to image specified in the 'Results' section.

TABLE 4
Trail -1

Robotic Inference Project - Parameters
Epochs : 10
Batch size : 64
Learning rate : 0.001
Prediction : toys and kitchen items are not correct

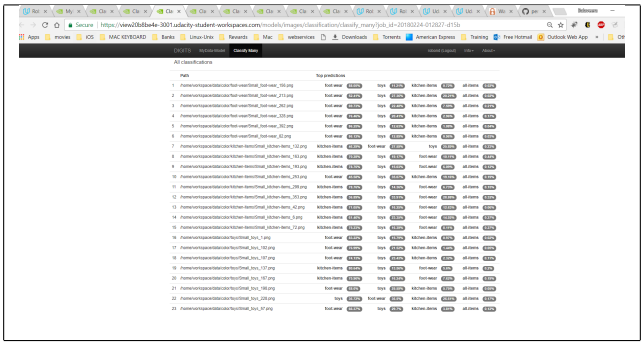
TABLE 5
Trail -2

Robotic Inference Project - Parameters
Epochs : 20
Batch size : 64
Learning rate : 0.001
Prediction : toys and kitchen items are not correct

TABLE 6
Trail -3

Robotic Inference Project - Parameters
Epochs : 20
Batch size : 64
Learning rate : 0.005
Prediction : foot-wear, toys and kitchen items are correct

TABLE 7
Trail -1 and Trail 2 - Prediction



6 Conclusion / Future work

Achieved a good accuracy in one environment, in order to be commercially viable this has to train and test the model in different possible home environment. In future, would like to concentrate on building a Robo-Maid model. In Order to create that model, below are the steps/tasks to be implemented

- First build model with the three classes (Kitchen Items, Foot-wear and Toys).
    1) Build models in different shades(background light) like morning, afternoon, evening, nights, all seasons for one home
    2) Then expand the model in different types of homes (different dimensions).
    3) Finally port the model into a physical device like Jetson.
- Second expand model by further classifying them to another 2 levels of classes from each class) train and test the model in different home environments and follow above steps
- For the Supplied DataSet model would like explore other networks other than AlexNet, in-fact want to try other networks on the Robo-Maid inference idea as well.

7 REFERENCES

1) https://adeshpande3.github.io/The-9-Deep-Learning-Papers-You-Need-To-Know-About.html
2) https://www.quora.com/What-are-the-differences-among-AlexNet-GoogleNet-and-VGG-in-the-context-of-convolutional-neural-networks