Machine Learning Nanodegree Capstone
Report: Dog Breed Classifier

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Domain background

Detecting and classifying dogs and differentiate among various breeds from images is a classic machine learning problem. It's a complicated problem also because it even seems very similar while looking with naked eyes let alone machine. Classic machine learning algorithms are not handy to solve this problem. Thanks God! Convolutional neural network works pretty well in this particular case.

Problem statement

The goal of this particular project is to build a ml model/process/pipeline to process real-world, user-supplied images to identify an estimate of the dog's breed. This process will be able to identify dogs/human and also differentiate different breeds of dogs. If image of a human is supplied, our process will estimate a dog breed that resembles the human face. An error message will popup if human/dog not detected. So, we will accomplish this task in two steps. First step would be to detect dog then to differentiate breeds.

Datasets and inputs

All the datasets used to train, test and validate the CNN model are provided by Udacity. Dog dataset [2] containing 133 breeds and each breed contains 8 images. Human dataset [3] which contains images, first names and last names. Total 13233 human images and 8351 dog images are available. We will use human dataset to detect human faces in images using ***Haar feature-based cascade classifiers-****is a implementation by OpenCV*. We will use dog dataset to detect dogs in images and we will use a pre-trained VGG-16 model. Datasets provided for this project is well justified.

Solution statement

Problem will be solved according to the following ways:

1. **Human face detection:** ***Haar feature-based cascade classifers*** by OpenCV.
2. **Dog Detection:** Pre-trained VGG-16 model with trained weights on ImageNet
3. **Dog Breeds Classification:** CNN model from scratch and transfer learning [1]

Benchmark model

I will use VGG-16: a pre-trained model trained weights on ImageNet as the benchmark model. Image-net has over 10,000,000 URLs with 1,000 categories. The pre-trained returns indexes from 151 to 268 inclusive, so must include categories from 'Chihuahua' to 'Mexican Hairless' as stated in the solution statement.

Evaluation metrics

We will evaluate the model by accuracy matric defined as follows:

Accuracy = TP+TN / TP+TN+FP+FN

Where,

True Positive(TP), True Negative(TN), False Positive(FP) & False Negative(FN).

Project design

- Step 0: Import Datasets from the particular folder containing data provided by Udacity
- Step 1: Detect Humans using Haar feature-based cascade classifiers
- Step 2: Detect Dogs using Haar feature-based cascade classifiers similar to human face detection.
- Step 3: Create a CNN to Classify Dog Breeds (from Scratch)
- Step 4: Create a CNN to Classify Dog Breeds (using Transfer Learning)
- Step 5: Write a Algorithm to detect dog and then differentiate dog breeds.
- Step 6: Finally test the algorithm.

Results & Discussion

From CNN model from scratch, we get around 8% accuracy which is bit lower than benchmark accuracy defined by Udacity. I the used transfer learning and got 46% accuracy which is also lower than the benchmark accuracy defined by Udacity. By doing the following task we could have come up with improved accuracy:

1. We see that training error is not decreased that much which means we could increase the complexity of the model
2. We see that validation error is fluctuating a bit so we could decrease the learning rate to stabilize the learning
3. We could have change increase validation data as I suspect due to the inefficient number of samples validation error fluctuating.

Bibliography

[1] https://keras.io/guides/transfer_learning/
[2] Udacity (2019).Udacity. [online] Available at: https://s3-us-west-1.amazonaws.com/udacity-aind/dog-project/dogImages.zip [Access 06 JUN 2020].
[3] Udacity (2019).Udacity. [online] Available at: http://vis-www.cs.umass.edu/lfw/lfw.tgz [Access 06 JUN 2020].