Capstone Project
Machine Learning Engineer Nanodegree

Shivam Tawari
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Dog Breed Classification

Domain Background:

It is very normal to see dogs on the streets everyday. Seeing them doesn't mean knowing them. Out of so many dog breeds, I can identify the German Shepherd and the Pug only. There are so many breeds looking similar and we cannot tell the differences. There are around 350 breeds of dog in the whole world. Identifying the breeds of the dogs is not a task humans can easily do, if we don't know much about dogs. There are thousands of dog breeds in the world. Some of these dog breeds are too close to differentiate from their images. Dog Breed Classification is a popular problem in Machine Learning. We can use supervised machine learning to solve this problem with the help of image classification using Convolutional Neural Network (CNN). And later we could build a web app to deploy the model. This project gives me a fantastic opportunity to build and deploy a ML model which has unbalanced dataset. That's why I have chosen this as my Capstone Project.

Problem Statement:

Identification of dog breeds is not an easy thing. Our main aim is to create a machine learning model which will do the following tasks:

- The model will identify which breed is present in the image input of a dog supplied by the user.
- The model will also identify whether the input of a human image is resembling any dog breed.

Datasets and Inputs:

A large set of dogs and human pictures were provided for training and testing purpose as part of the project. The dataset for the project is already been provided by the Udacity Machine Learning Engineer Nanodegree Program.

Humans Dataset: There are 13233 total human images which are sorted by their names.

Dogs Dataset: The dog image dataset has 8351 total images which have 133 breeds of dog. The dataset is sorted in the following manner:

Train: The train folder has 6680 images of 133 breeds of dog with 25-70 images per breed.
Test: The test folder has 836 images of 133 breeds of dog with 5-10 images per breed.
Valid: The valid folder has 835 images of 133 breeds of dog with 5-10 images per breed.

The number of images provided are imbalanced per breed. And each image does not have a clear background, some have one or more humans or dog in a image.

Solution Statement:

For creating this Machine Learning Model of Dog Breeds Classification we will use Convolutional Neural Network (CNN). A Convolutional Neural Network (CNN) is a type of Artificial Neural Network used in image recognition and processing that is specifically designed to process pixel data. Initially we use OpenCV's Haar Cascades for face detection. Then a pre-trained model which will help to detect dogs. Finally after identification of input image, we will use a trained model using Convolutional Neural Network (CNN) to detect the breed of the dog out of 133 breeds based on the input.

Benchmark Model:

- ⋆ The Convolutional Neural Network model prepared from scratch should have accuracy of atleast 10%.
- ⋆ The Convolutional Neural Network model created using transfer learning must have accuracy of 60% and above.

Evaluation Metrics:

The dataset is not balanced, thus using accuracy as a measure the performance of the model will not be a good idea. Hence we use Multi Class Log Loss to evaluate the performance of the model. The Log Loss metric takes into account the probabilities underlying your models, and not only the final output of the classification. Log Loss it useful to compare models not only on their output but on their probabilistic outcome.

Project Design:

Step 1: Import all the required datasets and required libraries.
Step 2: Pre-process the data and perform the image augmentation.
Step 3: Develop component using OpenCV's Haar Cascade classifier to Detect Humans.
Step 4: Develop component using pre-trained VGG-16 model to Detect Dogs.
Step 5: Develop a CNN network to classify breeds.
Step 6: Using Learning Transfer method, we will develop a new CNN to classify breeds.
Step 7: Train and test the model and check the accuracy.
Step 8: Write an algorithm to combine Dog detector and human detector.

- If dog is detected in the input image, return the predicted breed.
- If human is detected in the input image, return the resembling dog breed.

References:

1. Original repository for Project
https://github.com/udacity/deep-learning-v2-pytorch/blob/master/project-dog-classification

2. What’s considered a good Log Loss in Machine Learning?
https://medium.com/@fzammito/whats-considered-a-good-log-loss-in-machine-learning-a529d400632d
3. VGG-16 | CNN model
https://www.geeksforgeeks.org/vgg-16-cnn-model/