Dog Breed Classifier

Domain background

The Federacion Cynologique Internationale (FCI) has published over 300 dog breeds.
http://www.fci.be/en/Nomenclature/

It is hard to tell the dog breed given the look of a dog even for the dog lovers. Many people will be interested to find out the breed of the dog that they have seen from social networks.

The project is to build a dog breed classification app to identify a breed of dog by a dog image. If a human image is supplied, it will identify the resembling dog breed.

Problem Statement

There are three problems that the project will need to address.
1. Detect if the image contains a dog.
2. Detect if the image contains a human face.
3. Identify the dog breed by either the dog image or human face image.

A web or mobile app will need to be built to handle the user supplied images. A CNN model will be trained and deployed to serve the app functionality.

Datasets and inputs

Two datasets have been provided by Udacity. They will be used for training/testing/validation.
- dog dataset
- human dataset

Dog dataset

In the dog dataset, there are 3 directories: train(6814 images), test(970 images) and valid(969 images). They are separated in 133 dog breeds folders. Every dog breed has some images.

They are in different sizes and different backgrounds. The images are from different angles of the dogs. All of them have dog faces.
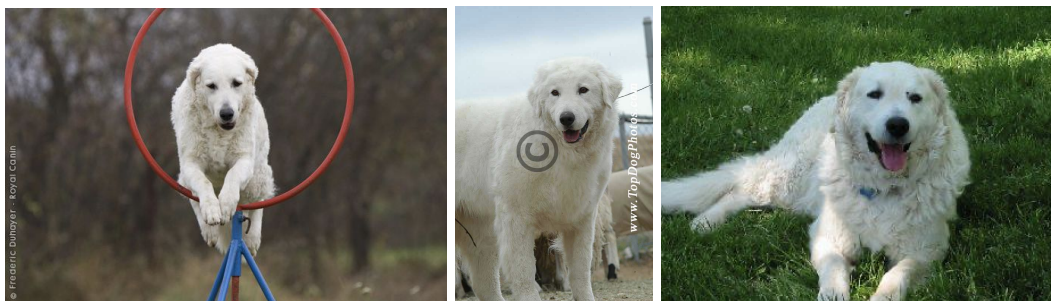
Silky Terrier

Papillon

Kuvasz

Human dataset

In the human dataset, there are 18983 images from 5749 people with the images in the folders with their names. All of human images are the same dimensions (250x250). Some of them have partial faces from other people.

Solution statement

Convolutional Neural Networks(CNN) will be used to build the dog breed identification app. The model will be used as the backend of the web or mobile app.

The app will accept user supplied images and detect if it is a dog or human and provide the estimated dog breed.

To detect the images, a computer vision algorithm will be used.

- For human face detection, OpenCV's implementation of Haar feature-based cascade classifiers will be used.
- For dog image detection, VGG-16 model, along with weights that have been trained on ImageNet will be used.

By using OpenCV and VGG-16 together with CNN model, the app will detect if it is a human or dog and provide estimated dog breed if it is a dog and resembling dog breed if it is a human.

Benchmark model

One of the latest dog breed classification research articles published on 01 October 2020 https://link.springer.com/article/10.1007/s41095-020-0184-6 for some deep neural classification models.

Table 3 Fine-grained classification accuracy of PMG [19], TBMSL-Net [23], WS-DAN [38], and Inception V3 [47] on our dataset

Model	Backbone	Batchsize	Epochs	Accuracy
Inception V3	—	64	200	77.66%
WS-DAN	Inception	12	80	86.404%
PMG	ResNet50	16	200	83.52%
TBMSL-Net	ResNet50	6	200	83.7%

Another article published on 2018 http://noiselab.ucsd.edu/ECE228_2018/Reports/Report17.pdf for some results of the existing models.

Table 2. Results out of different pre-trained model

Model	test accuracy	reference
VGG-19 and Resnet-50	82.30%	[2]
VGG16BN	76.53%	[3]
VGG16	40.23%	[3]
ResNet50	85.50%	[4]
ResNet50	84.00%	[5]
Inception v3	74%	[5]

Evaluation metrics

Since the model will be used to detect humans and dogs then provide estimated dog breed, there are 2 metrics to evaluate the performance.

1. The accuracy of human/dog detection.
2. The accuracy of the dog breed estimation.

Project design

Data preprocessing

Download the datasets provided by Udacity then unzip them to the location that the code can access.

The datasets are already prepared in the train/test/validate folder with the right amount of files. There are no extra steps required.

Detect humans

Convert the images to grayscale then use OpenCV pre-trained face detectors to detect human faces.

Detect dogs

Pre-trained VGG-16 models along with weights that have been trained on [ImageNet](#) will be used to detect dogs.

Dog breed classification model

Create a CNN to classify dog breeds from scratch. 2D Convolutional Layers will be used (number of layers are to be determined) and Max Pooling will be used to reduce the number of parameters.

Create an improved CNN via Transfer learning by reusing the data loader created earlier. Existing pre-trained models will be used to create this model.

Integration

Setup the integration process to detect the humans/dogs from a given image and output the predicted dog breed from the CNN model.