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Capstone Project : Dog Breed Classifier

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DEFINITON

Project Overview

Image identification is a well known problem in Artificial Intelligence. Image identification projects can be either face detection, detection of objects , text detection and detection of landmarks or symbols and logos. This project aims to build a program that can not just identify a face of a Dog but also be able to detect which breed the dog belongs to. The project uses Convolutional Neural Networks which are specialized kinds of neural networks that have been very successful particularly at computer vision tasks, such as recognizing objects, scenes, and faces, among many other applications for this task. We also implement a program which detects the human face and outputs the nearest dog-breed-face it resembles!!.

Problem Statement

The goal is to implement a program that takes a picture of a dog as an input and outputs the breed of the dog. If the face belongs to a human it is able to detect the human face and output the closest dog breed face it resembles. The following are the tasks involved

1. Download the dog and human faces datasets.
2. Implement a human face detector.
3. Implement a dog face detector and breed predictor using below two methods
   a. Creating a CNN classifier and training it from scratch.
   b. Creating a CNN classifier using Transfer Learning and then training the model.
4. Implement a final program to input an image and output as follows
   a. if a **dog** is detected in the image, return the predicted breed.
   b. if a **human** is detected in the image, return the resembling dog breed.
   c. if **neither** is detected in the image, provide output that indicates an error.

ANALYSIS

Data exploration

There are two datasets and five pre-trained models available to us.

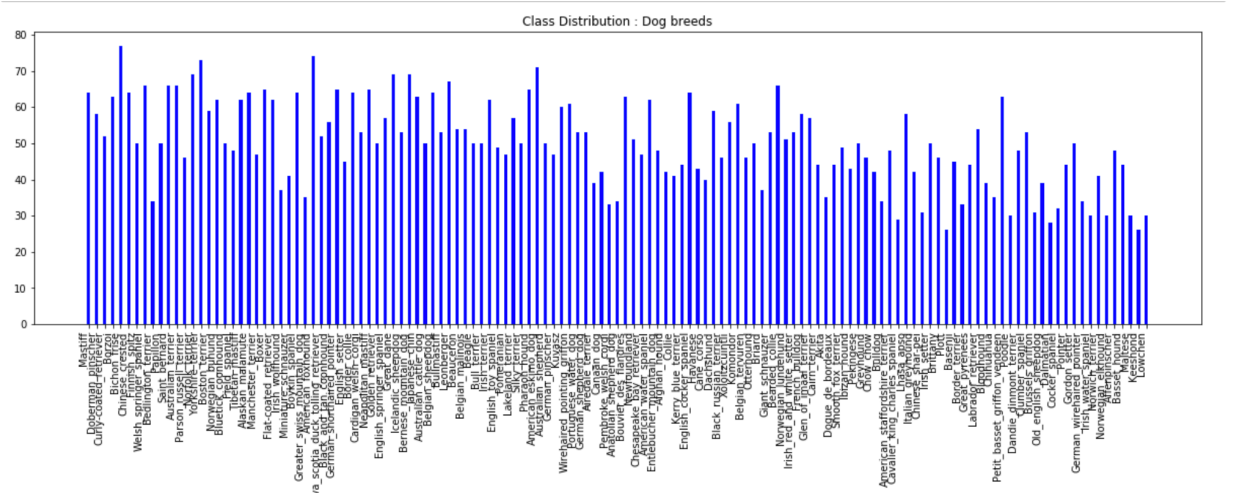
Dogs dataset : Dog dataset provided by Udacity deep learning v2 PyTorch repository. (https://s3-us-west-1.amazonaws.com/udacity-aind/dog-project/dogImages.zip)

Humans dataset : Human dataset provided by Udacity deep learning v2 PyTorch repository. (http://vis-www.cs.umass.edu/lfw/lfw.tgz)

There are 13233 total human images and 8351 total dog images.
There are 6680 dog images in the train folder and 836 dog images in the test folder and 835 dog images in the valid folder.

Exploratory Visualization

There are 133 breeds of dogs and the breed-wise class distribution of the dogs is as shown below



The above class distribution of the training data set shows that the data is not exactly balanced . There is a definite variation in the count of different breeds available and this shall have an effect on our accuracy.

IMPLEMENTATION

Algorithms and Techniques

The classifier is a Convolutional Neural Network, which is the state-of-the-art algorithm for most image processing tasks, including classification. We initially implement a CNN from scratch and then implement a CNN using transfer learning.

Benchmark and Accuracy

We use the provided accuracy benchmarks int he notebook aiming for a higher than 10% accuracy for the CNN built from scratch and higher than 60% accuracy for the CNN built using transfer learning.

Methodology

The following is the methodology to realize our solution.

1. Import Datasets. We shall import the given dog and human datasets.
2. Detect Humans. We shall use OpenCV's implementation of Haar feature-based cascade classifiers to detect humans.
3. Detect Dogs. We shall detect the Dogs using VGG-16 model.
4. Creating CNN We shall create a CNN for detecting Dogs.
5. Creating CNN using Transfer Learning. We shall now create a CNN using transfer learning.
6. Algorithm. No we shall write an algorithm that accepts a file path to an image and first determines whether the image contains a human, dog, or neither. Then,
   - if a **dog** is detected in the image, return the predicted breed.
   - if a **human** is detected in the image, return the resembling dog breed.
   - if **neither** is detected in the image, provide output that indicates an error.
7. Testing. Finally we shall test this algorithm on at least six sample images.

CONCLUSION

We were able to implement a program that could accept an image as an input and detect whether the image contained a dog face or a human face. If the image contained a dog face it would proceed to identify the breed of the dog using the classifier we built using transfer learning and trained to get a 84% accuracy. If the image contained a human face it would output the closest matching dog-breed. We found that tuning the hyper parameters and selecting the best pre-trained model (VGG-19) in our case and the length of training plays a great part in getting better results.