

Machine Learning Engineer Nanodegree

Dog Breed Classifier using CNN

Capstone Proposal

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Domain Background

The dog breed classifier project is well known in the Computer Vision domain. The primary competition for this was first raised in Kaggle in 2017, where the primary objective was to distinguish the various breed of dogs. As there are various breeds of dogs available it would be very interesting to identify a dog's breed through an image. As the target of this project, I would be building an interface through which an image can be pushed into a data pipeline to pass to a Convolutional Neural Network (CNN). There are many types of breeds against the dataset, which makes it a multi-class classification problem. A fun aspect of this project is to input images of humans and see the breed against which they match the most. The interface would take as input any image a run pre-trained model to classify a human or not and based on that would go through the processing pipeline for classification.

Problem Statement

The goal of this project is to explore the challenges in processing an image and extract information out of it and build a machine learning pipeline to process it and classify it into the type of dog breed. The primary target for the project is as follows:

- Dog Classifier – Given an input image, extract the important features and process through a Convolution Neural Network to get the correct classification of dog breed.
- Human Classifier – Given an input of a human face, identify it as a human face and then extract the important feature which classifies that image as most matching with a dog breed.

Datasets and Inputs

For the project training and processing, I would be using the dataset available through the Udacity project repository. The dataset can be a replica of the Kaggle competition dataset or a subset of that.

The dog image dataset has 8351 total images that are sorted into train, test, and validation directories. Each of these directories has 133 subfolders corresponding to the dog breeds. There various types of images with different features like background, colors, or sizes which must be normalized through preprocessing to be processed in the same pipeline.

If there is a larger set available for more types of dog breeds, that can also be used for training of the model. That can be researched in the later part of the project for better training or classifying more dog breeds.

Human Image contains 132333 total human images which are sorted by names of humans (5750 folders). The dataset for training is not balanced with some sets having multiple pictures and some having very few images.

Having said that, the primary input for the project would be a python Flask based website which will be taking input an image. There will be some significant filtering of images to preprocess the important aspect of the image which will help classify the image.

Solution Statement

The primary solution of the project is to process the images in scales through a Convolutional Neural Network which is a Deep Learning algorithm. The neural network will reduce the processing features based on pooling to a set of important vectors which will be passed to a cost function for multiclass classification. One of the most well-known multiclass classification cost function is the log loss function which will be executed at the final stage of the neural network.

The overall solution will include the step of classifying human images as well which would be the first step in the preprocessing framework. For classifying the human dataset, we will be using a pre-trained classifier provided by the OpenCV classification algorithm. After the image has been identified as a human or dog it will be passed to the respective classification pipeline for identifying the best out of the 133 dog breeds.

Benchmark Model

For our benchmark model, we will use the Convolutional Neural Networks (CNN) model created from scratch with an accuracy of more than 10%. This should be enough to confirm that our model is working because random guess would be 1 in 133 breeds which are less than 1% if we don't consider unbalanced data for our dog images.

Evaluation Metrics

For evaluating the machine learning model, we will consider a multiclass log loss cost function as our evaluating method. The log loss function will consider the imbalance in class in the dataset and will help in evaluating the model. Accuracy wouldn't be the best measure of performance of the model, instead, targeting for a high AOC based on Precision and Recall would be the goal of evaluating the performance.

Project Design

The following steps will be taken as part of the project design approach:

- Step 0: Import Datasets

Import the necessary dataset and python libraries required by the project, preprocess the dataset train, validation, and test. Perform any kind of image manipulation necessary before input into the next classification stage.

- Step 1: Detect Humans

Detect humans based on OpenCV's implementation on face classifier

- Step 3: Create a CNN to Classify Dog Breeds

Create a CNN to classify dog breeds from scratch based on the training and validation dataset

- Step 4: Write your Algorithm

Write an algorithm to combine the dog and the human classifier to perform the following functions:

- If a dog image is detected, returns the predicted dog breed
- If a human face is detected, return resembling dog breed
- If neither of them is detected, then return misclassification error

- Step 5: Test Your Algorithm

Test your algorithm using the test data using the evaluation matrix to check the model output performance