Machine Learning Engineer Nanodegree

Capstone Proposal
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Proposal

⇒ Domain Background:

Identifying dog breeds is a complex challenging task that humans find difficult to accomplish without some help from machine learning and computer vision. It involves image recognition and classification that use machine learning techniques to assist computer vision.

A machine learning approach to image classification, a supervised learning problem entails defining, identifying and obtaining key features from images and using them as input to a machine learning model. Early computer vision models relied on raw pixel data as the input to the model. Also, image classification is a machine learning method, and it is designed to resemble the way a human brain works. With this method, the computers are taught to recognize the visual elements within an image.

A breakthrough in building models for image classification came with the discovery that a Convolutional Neural Networks which is an architecture of a neural network that is commonly used for image classification could be used to extract higher and higher-level representations of an image content. Instead of preprocessing the data to derive features like textures and shapes, a CNN takes an image's raw pixels data as input and learns how to extract these features and identify what object they constitute.

I have decided to write a proposal on how to classify the breed of a dog. I will discuss the steps to build and train a Convolutional Neural Networks (CNNs) that will classify different breeds of dogs on a picture that represent a dog and a human.

⇒ Problem Statement:

To identify a dog's breed from a given set of images of both dogs and humans, we will need to create a model with good accuracy. The goal of the project is to answer two questions: What dog breed is on the pictures of various dogs and what breed of dog will an image of a human represent. To accomplish this task, a machine learning model that will predict an estimate of the breed of the dog based on a picture of a dog or a human will be created.

The algorithm will perform two tasks:
Use a dog face detector to identify an estimate of a dog's breed from a dog's image and use human face detector to identify the most similar dog breed from a human's image.

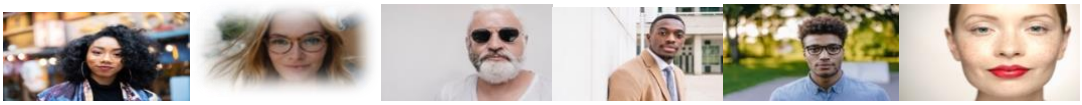
⇒ Datasets and Inputs:

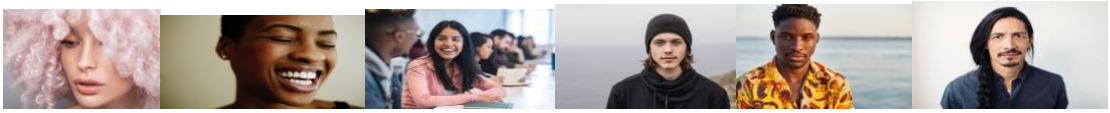
The datasets and inputs are images that will be used in the project provided by Udacity. The input format is of the image type. They are divided into the dog dataset and the human dataset:

The dog dataset is comprised of 8,351 dog images which are subdivided into training, test and validation data. There are 6,680 images to train the model, 836 images for testing and 835 images for validation.

The entire dataset contains 133 different dog breeds. The images sizes and backgrounds are of different sizes and backgrounds. They are not the same. The data will not be balanced. Some breeds of dogs will have 4 images while the other breeds will have 8 images. The lightning is not the same which is totally fine because the model will work on different types of images.

The human dataset is comprised of 13,334 images and 5750 folders. These images are used to test the performance of the human face detector. All the image sizes are 250 x 250. The images will have different backgrounds and different angles, lightning and some images will have more than one face (human or dog) on the image. Below are just sample images of dogs and humans to illustrate what the datasets provided by Udacity would look like:





⇒ Solution Statement:

To solve the problem of identifying the breed of a dog, we will use Convolutional Neural Networks (CNN)which analyzes visual imagery to design a model that will estimate a possible dog breed from pictures of dogs and humans. This solution will involve three steps:

- Using OpenCV's implementation of Haar feature-based cascade classifiers to detect human faces in images.
- Using a pretrained VGG16 model to detect dogs in images of both humans and dogs.
- Passing the images to a Convolutional Neural Network that will process the image and predict the breed that matches the image.

⇒ Benchmark Model:

The Convolutional Neural Networks (CNN)model created from scratch with an accuracy of at least 10% will be used as the benchmark model. This baseline solution is enough to confirm that the problem is solvable and that the model will work.

⇒ Evaluation Metrics:

The goal is to correctly predict the breed of a dog's image. Therefore, I would propose using accuracy which is how many times the model predicts the correct breed of the dog as an evaluation metric to improve the model after each iteration. If a dog is detected in the image, I want the accurate predicted breed. If a human is detected in the image, I want the accurate resembling dog breed to that human's image. And if neither dog nor human is detected in the image, I want an accurate provided output that will indicate that an error has occurred.

⇒ Project Design:

The project will involve the following steps:

- Step 1: To be able to build an algorithm intended to identify dogs breeds, we will need to import the dataset using the correct path and print the number of images in each dataset.
- Step 2: Then detect humans faces in images using OpenCV's implementation of Haar feature-based cascade classifiers.
- Step 3: We will also have to detect dogs faces on images using a pretrained VGG16 model.
- Step 4: After that, we will create a CNN to classify dog breeds from scratch- attaining a test accuracy of at least 10%. Then train, validate, and test the model.
- Step 5: In addition, we will create a CNN to classify dog breeds using Transfer Learning. Then we will also train, validate, test the model and predict dog breed with the model. The CNN must attain at least 60% accuracy on the test set.
- Step 6: Finally, we will write and test the algorithm that accepts a file path to an image and determine whether the image contains a human, dog, or neither- an algorithm to combine dog detector and human detector:
    - 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 an output that indicates an error.

References:

https://en.wikipedia.org/wiki/Convolutional_neural_network
https://machinelearningmastery.com/how-to-know-if-your-machine-learning-model-has-good-performance/
https://iq.opengenus.org/basics-of-machine-learning-image-classification-techniques/