MACHINE LEARNING ENGINEER NANODEGREE

CAPSTONE PROPOSAL

DOG BREED CLASSIFIER

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Domain Background

Human Beings have conquered the world with their cognitive capabilities, yet there are some tasks that would need external assistance. This Capstone Project aims to deal with one such case. Image classification is a modern problem, and a lot of development has been taking place in that area. With drastic advancements in the face of hardware technology, we are now able to concentrate more on problems at hand rather than the computational difficulties. For example, automation of major medical tasks like detecting tumors, cancers, cysts now allow the doctors to utilize their time effectively and pay attention to much more important tasks.

Consider dog breed classification, hundreds of varieties of breeds could be difficult for a human to memorize. Keeping the memory limitations of a human aside, it would take only a true canine expert to differentiate among all the breeds available, as there are breeds with extremely minimal differences. To deal with these problems, humans can use Machine Learning Models that help recognize the dog's breed through an image. The chosen project is a classification problem and uses CNNs to solve it. I chose this problem for my capstone project because I believe it would be a perfect means to epitomize the use of CNNs and demonstrate a dog breed classifier. To mention another non-technical reason for me being drawn towards this problem is my love for dogs.

Problem Statement

The chosen project is a classification problem, which must be solved with the help of CNNs. The goal of this project is to develop an algorithm that could classify a dog breed and be used as part of a mobile or web app. The algorithm will accept any user-supplied image as input. If a dog is detected in the image, it would provide an estimate of the dog's breed. If a human is detected, it would provide an estimate of the dog breed that is most resembling.

Datasets and Inputs

The data source for this project is UDACITY itself as it provides all the data required for training, testing, and validating the ML model. There are 2 categories of datasets being used in the project, one is a dataset of human images and the other is of dogs. The human dataset contains 13233 images of real people overall. Each person's images are present in varying proportions. The dog dataset has a total of 8351 images of various breeds. There are 133 breeds overall, out of which each breed's pictures are in varying amounts. The training dataset comprises 80% of the dataset and has 6689 images. The test and validation datasets sum up the rest of the 20% with 835 (10%) and 836 (10%) images respectively.

Solution Statement

Firstly, the project needs to detect if a given image consists of a human or a dog. Later, if the image is of a dog, it needs to classify the breed. If a human is detected, it needs to return the breed of the dog that the human resembles the most. To detect a human face, Haar feature-based cascade classifiers of OpenCV can be used. Further, to detect a dog, a pre-trained VGG16 model would be apt as it was trained using ImageNet data which has numerous labeled dog images. Finally, to classify the breed, a CNN pre-trained on ImageNet data can be implemented as it would already be capable of detecting the features of dogs to an extent.

Benchmark Model

A benchmark model would satisfy the following criteria:

- The CNN trained from scratch needs to classify the images in the test dataset with at least 10% accuracy.
- The CNN model trained using transfer learning must achieve a minimum of 60% prediction accuracy on the test dataset.

Evaluation

The evaluation metrics used in this project will be accuracy. Accuracy is simply the ratio of correct predictions to the total number of predictions made.

$$\text{Accuracy} = \frac{TP + TN}{TP + TN + FP + FN}$$

TP -> True Positive

TN -> True Negative

FP -> False Positive

FN -> False Negative

Project Design

Step 0: Import Datasets

The data required for the project needs to be imported and analysed.

Step 1: Detect Humans

OpenCV's Haar feature-based cascade classifier needs to be implemented to detect humans in a given image.

Step 2: Detect Dogs

Using pre-trained VGG16 model, a dog detector needs to be created.

Step 3: Create a CNN to Classify Dog Breeds (from Scratch)

A CNN to classify dog breeds must be built from scratch. The model needs to have an accuracy of at least 10%.

Step 4: Create a CNN to Classify Dog Breeds (using Transfer Learning)

A CNN to classify dog breeds must be built using transfer learning using a suitable pre-trained model. The model needs to have an accuracy of at least 60%.

Step 6: Write an Algorithm

An algorithm needs to be built that will identify if an image has a dog or a human. Further, it needs to return the dog breed in case a dog is detected, else it must return the dog breed the human most resembles. If neither a human nor a dog is detected, an error must be returned.

References

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