Machine Learning Engineer Nanodegree

Capstone Proposal

Dog Breed Classifier with CNNs

Hassan Raza Bukhari

26th October, 2020

Domain Background

There are currently over 300 identified dog breeds all around the world and identifying them is an interesting problem and this problem. Distinguishing different animals would be relatively easier but distinguishing precisely the breed of a dog is somewhat difficult and it is not immediately clear that which features to be used for this purpose and which algorithm might prove to be useful. Clearly this is a multi-class classification problem which must utilize a robust algorithm to be accurately identify the dog breed. Convolutional Neural Networks (CNN) has proved to be very effective for similar applications classifying different objects, so it would be a good idea to utilize that. It must also be noted that some dog breeds have very similar features and are very hard to distinguish even for humans as well. Therefore, CNN based classifier might also face issues in being able to distinguish certain dog classes from each other. Testing it on data would show much accurate the predictions are.

Problem Statement

In simple words the problem statement is, *When given input image of a dog, identifying the breed of that dog and when given image of a human, identifying the resembling dog breed.*

The classifier solves two problems

Dog Breed Classification: The classifier will be able to classify images of dogs into different breeds.

Human face classification: The classifier will classify human face image into resembling breed of dog.

Datasets and inputs

Two datasets will be used for this project.

Dog Dataset: Dog Dataset containing images of different dog breeds. It contains 8351 images having 131 different dog breeds. Images are divided into train and test datasets

Human Dataset: This dataset includes a set of human images to be used during the project. It contains 13233 images.

Solution Statement

The problem is to classify dog images based on their breed. The solution that is going to be used in this project is to use Convolutional Neural Networks (CNNs) to classify the images. CNNs is an algorithm that will make reasonable classification of images based on different extracted features from the images. The similarity of those features would put images in one group, while

some fundamental difference among the features will cause the image to be placed in a different class.

Benchmark models

- For self-evaluation of model, since there are 133 different breeds of dogs in the dataset of this project, thus randomly guessing the breed of a dog would give us less than 1% accuracy. Therefore, our model built and trained from scratch using CNN should produce an accuracy of at least 8%– 12%, while the one with transfer learning should have accuracy of around 60%.
- The accuracy can also be compared with these benchmark algorithms

S.No	Authors	Methods used	Data sets used	Training (Images/%)	Testing (Images/%)	Accuracy
1	Sharma N, et. al.[1]	Transfer learning with AlexNet, GoogleNet, ResNet50	CIFAR10	50000	10000	GoogleNet-68.95%, ResNet50-52.55%, AlexNet-13%
			CIFAR100	50000	10000	
2	Krizhevsky, A, et.al.[5]	Proposed a network contains 5 convolutional and 3 fully connected layers	ImageNet Fall 2011, 15M images, 22K categories,	7.5M	7.5M	Error rates top-5 : 37.5%, top-1 : 17.0%.
3	Hana D, et al.[10]	Transfer learning, web data augmentation technique with Alex,vgg16,res net-152	Flowers102	8189		92.5%
			dogs	20580		79.8%
			Caltech101	9146		89.3%
			event8	1579		95.1%
			15scene	4485		90.6%
			67 Indore scene	15620		72.1%
4	Hussain, M.et.al. [12]	Transfer Learning with Inceptiov3 model	CIFAR10	50000	10000	70.1%
			Caltech Face	12150		65.7%
						500 epochs-91%
						4000 epochs-96.5%
5	Loussaief, S, et. al. [14]	CNN deep learning	Caltech 101	9146		96%

Evaluation Metrics

The evaluation metrics used for this project would be **Accuracy Scores.** The approach is to use the classifier to classify test images, then use the predicted labels and compare them with the true labels to evaluate the accuracy of the algorithm and thus estimating how well it performs on new data.

Project Design

The project design would be as follows:

1. Importing the datasets
2. Detecting Humans
3. Detecting Dogs

4. Creating a CNN to classify dog breeds (from scratch)
5. Creating a CNN to class dog breeds (from transfer learning)
6. Writing the algorithm
7. Testing the algorithm

References

1. **Base Repository**: Original [GitHub repository](#) used as a base for this project.
2. **Domain Knowledge:** [Using Convolutional Neural Networks to classify dog breeds](#)
3. **Datasets:** [Dog Dataset](#) and [Human Dataset](#)
4. **Benchmark Models:** [Deep Learning and Transfer Learning approaches for Image Classification](#)